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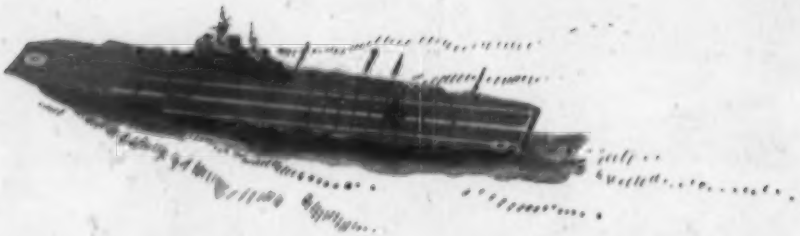

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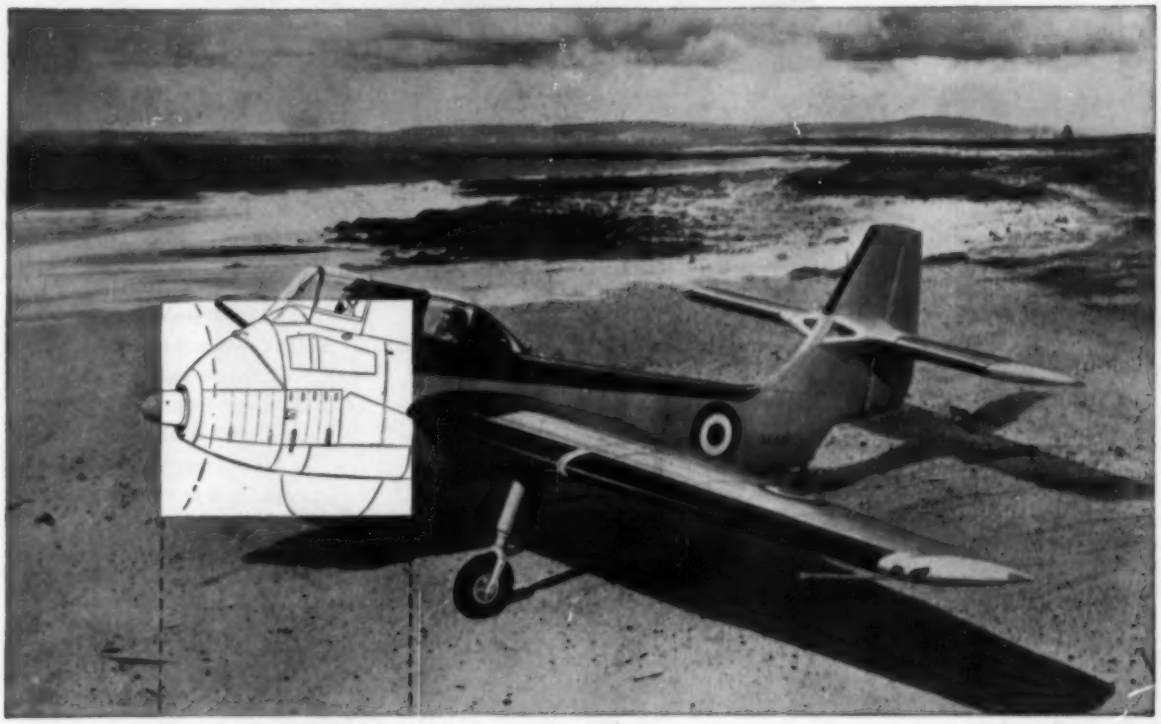

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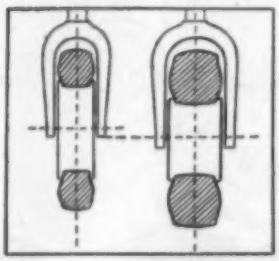

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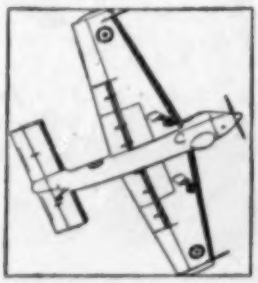

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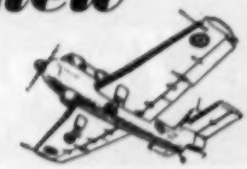

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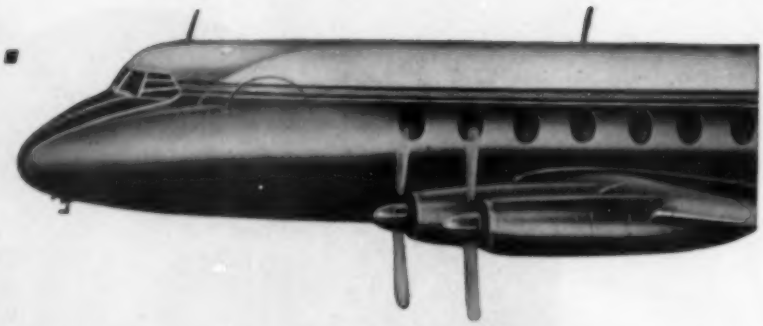

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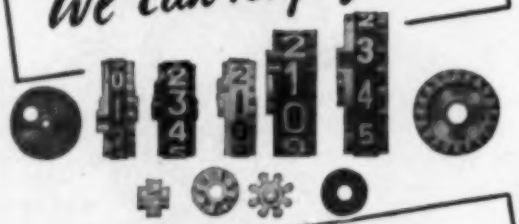

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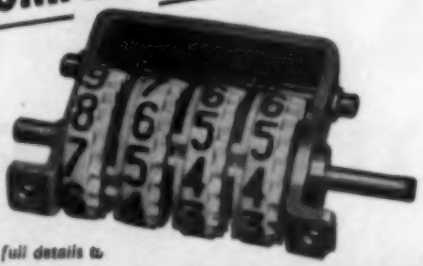

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Write for reprint of article in 'The Motor' June 15th 1955 on "Testing Cars for Noise and Vibration"

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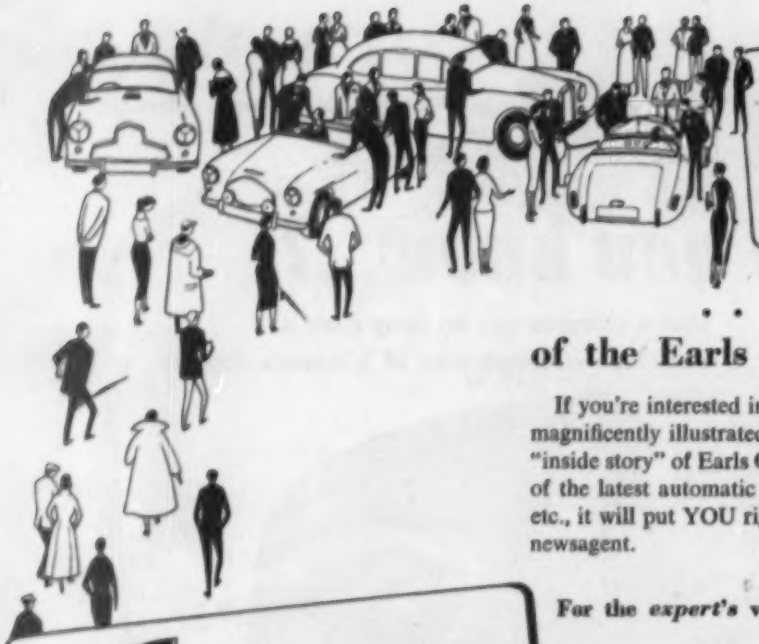

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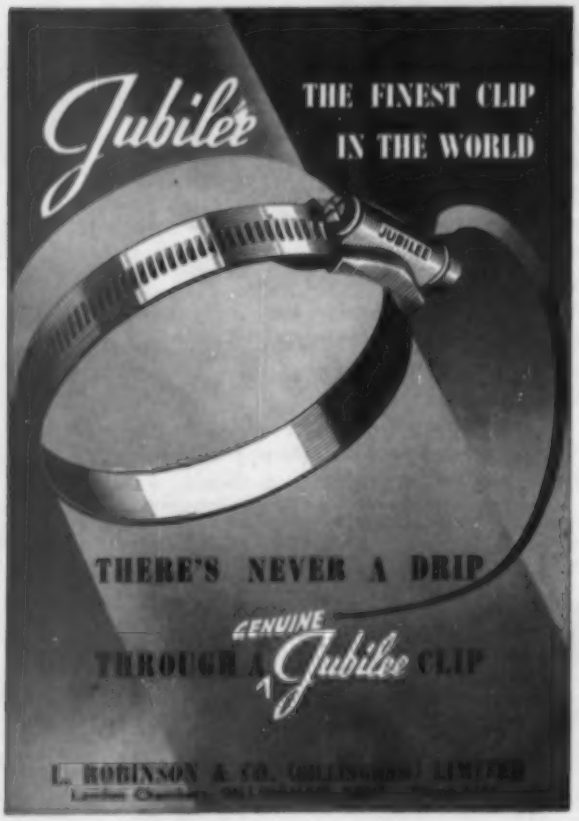

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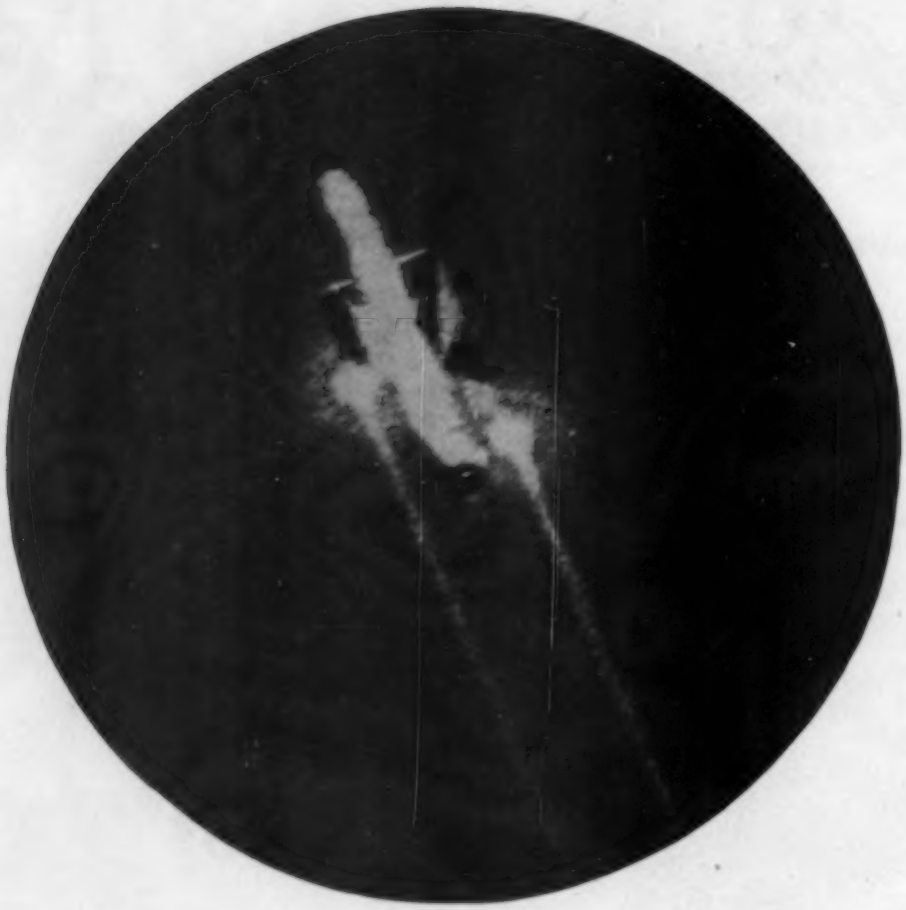

MINDS OF THEIR OWN

Guided Weapons are missiles into which have been built powers of sight, of calculation, and of control —in fact, powers of exercising judgement. This is a fantastically difficult problem. It involves mechanics, hydraulics, and electronics of a complexity beyond all previous experience. It is also a fascinatingly interesting problem, this endowing of the machine with almost super-mechanical abilities—in short, with something of the powers of a human pilot.

The development of such a weapon and the whole system associated with it poses enormous problems. In this work the ENGLISH ELECTRIC Group—English Electric, Marconi's, and Napier—are far advanced. This is not surprising, for their combined resources and experience are exactly those required for this difficult work.

The past achievements and present activities of the Group in the Guided Weapons field are considerable, but the national interest demands that they be kept secret. Much remains to be done in the future. How long it will take will depend largely on the efforts of the highly qualified men guiding the research and development teams. Some of these men have long been working on the problem; more must now be found. They will have heavy responsibilities, great opportunities and the finest equipment.

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FLIGHT
and
AIRCRAFT ENGINEER

First Aeronautical Weekly in the World

Founded 1909

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Experienced Engines—

WE have always had a profound respect for the engineering ability of Pratt and Whitney—a respect which extends also to Mr. Frederick B. Rentschler, who was principally responsible for founding the company as aero-engine producers 30 years ago. It is, therefore, the more distasteful to read reports that Mr. Rentschler is trying to decry British progress in engine development.

According to these reports, he told a Press conference in New York that some British jet engines were purely on paper, some were experimental, some had been in "so-called production and military service," but that few had been produced in hundreds and that only certain relatively low-powered engines had been produced by the thousand. British experience was, therefore, "sharply limited."

Now this sort of talk is unworthy of a fine engineer. He should not be surprised to find that we have some engines purely on paper and others which are experimental; it would be most unhealthy for our industry if this were not the case. Neither should there be any cause for comment in the fact that most of our turbojet production has been of engines which are of relatively low power. The same applies to Mr. Rentschler's own country, where 80 per cent of their total production has involved engines of less than 6,000 lb thrust. Naturally, we cannot attempt to match America in numbers of engines; the General Electric Company, for example, have now delivered nearly 40,000 J47 turbojets, a figure which no European firm can begin to parallel. But the British industry has no reason to feel dissatisfied with its development and production record of engines and—with the single exception of Mr. Rentschler's own excellent J57—America has nothing to equal the five-figure-thrust Avon, Olympus and Sapphire, all of which are in full production—not "so-called" production.

It is also pertinent to remember that British engines have been no small help to the United States; in fact, Mr. Rentschler's own company recently received a repeat order for a turbojet of basic Rolls-Royce design.

—and Commercial Experience

Mr. Rentschler is also reported to have said "our American plan for the development of a commercial engine always stems from a type originally conceived for military application. Until the engine has had a broad military production and application, it is not deemed available for consideration for transports. We believe this system is responsible for what can realistically be termed the supremacy of American powerplants to date . . . with one or two trivial exceptions, nothing except American planes equipped with American-designed and manufactured engines have been used in inter-continental and over-ocean commercial flight to date."

We do not quarrel with the contention that America has, in the past, been the world's chief builder of commercial aero engines. We do disagree with the suggestion that a suitable airline powerplant has to stem from a military engine. Both Mr. Rentschler and his chief engineer, Leonard Hobbs, have so far refused to accept the fact that the record of the Rolls-Royce Dart in half a million hours of commercial service has been so far ahead of the level of reliability set by American piston engines that it has been suggested that engine failure at take-off may no longer need to be considered as a prime factor in planning the design of transports. Yet neither the Dart nor Bristol's fully-certificated Proteus have ever served in a military unit.

We believe that the policy advocated by Mr. Rentschler is a mistaken one. Military service is no substitute for airline operation (either real or simulated). To quote one example, the past year's Britannia flying has probably done as much to make the Proteus a reliable civil engine as all the hours logged by military J57s will ever do for the forthcoming Pratt and Whitney commercial turbojets. In stating this we are not denying the value of military service; obviously it is better to have a million hours of Service flying as a basis on which to build than to have nothing at all. But present indications are that our engine designers have demonstrated that military experience is not essential.

FROM ALL QUARTERS

Britannia's First Dollar Order

AN order worth $10m (£3.6m) for Bristol Britannias was announced jointly by Canadian Pacific Airlines and the Bristol Aeroplane Co. on October 20th. Three Britannia 300 L.R.s have been ordered by C.P.A.L. for delivery in 1956 and the airline holds an option on a further five for delivery at a later date.

Initially, the Britannia will fly on the airline's long-haul Pacific route, linking Vancouver with Honolulu and extending to Tokyo and Hong Kong; it is intended also that Britannias will operate C.P.A.L.'s new trans-polar service between Canada and Europe. Non-stop flights between Vancouver and Amsterdam can be achieved by a Britannia carrying 100 passengers in 12 hours, and it is likely that a similar block-to-block time will be logged on the Vancouver to Tokyo route.

Announcing the order, the president of C.P.A.L., Mr. Grant McConachie said: "When the Britannia comes into operation it will be superior in performance to any other airliner in service on the air routes of the world at that time." As in the Britannia 300s on order for other operators, power units will be Proteus 755 turboprops, of 4,120 e.h.p. each, and cruising speed of the aircraft is expected to be a little more than 400 m.p.h. All-up weight will be 170,000 lb.

C.P.A.L.'s present long-range fleet consists of four DC-6Bs. Their Britannia contract brings to 42 the number of Britannias now on order (B.O.A.C., 33; El Al Israel Airlines, three; and the R.A.F., three). It is understood that C.P.A.L.'s interest in the Comet 4 (*Flight*, April 29th) continues, and that jet-airliner operation in partnership with the turboprop fleet is being closely studied.

Missile Fishing

SUCCESSFUL experiments at the Woomera rocket range have been made in catching expended, parachute-borne rocket missiles before they reach the ground, thus further decreasing the risk of damage. According to a report from Australia, an aircraft is sent up to intercept the falling missile, from which hangs a long cable. The aircraft itself tows a 500ft cable terminating in a device comparable with a naval paravane, which has the effect of making the cable trail in a horizontal plane at an angle from the aircraft; and this cable is equipped with grapnels. When the parachute is intercepted, its trailing cable is caught by the grapnels on the paravane cable.

Finally, it appears, the aircraft flies low over a gully spanned by cables, so that the missile is transferred from the aircraft to one of the other cables, where it hangs undamaged until collected.

The new method was invented by Mr. H. G. Pritchard, a former works superintendent at the Woomera Weapons Research Establishment.

Airborne Atoms

IT is reported from Washington that, by the end of the current financial year, the total American expenditure—principally on behalf of the U.S.A.F.—on nuclear-powered aero engines will amount to some $230m (£82m), and a first-flight date is being predicted for 1958-59.

Companies named as prime contractors for U.S.A.F. nuclear engines include General Electric, Pratt and Whitney and Curtiss Wright. Airframe companies involved include Convair, Boeing, Lockheed and (for the Navy) Martin. Convair (Fort Worth Division) recently installed a reactor in a B-36 to determine considerations of shielding, but this installation is not for flight.

R.N. Carrier Disposal

IT was announced last Monday that a total of four fleet carriers of the Royal Navy reserve fleet are to be broken up or otherwise disposed of. They are *Illustrious*, *Indomitable*, *Indefatigable* and *Implacable*, all of around 25,000 tons normal displacement and commissioned during World War 2.

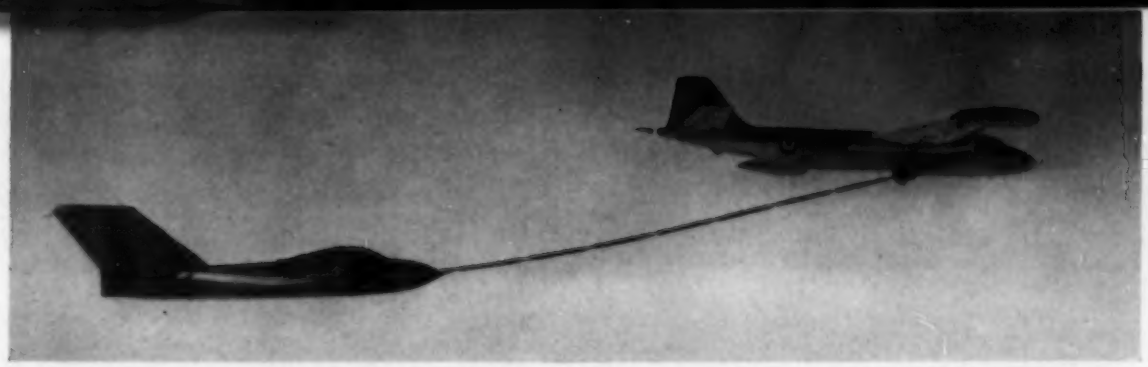
Of the fleet carriers of this vintage, only *Victorious* (originally 30,000 tons) has been thought worth rebuilding to modern standards, with angled deck, steam catapult and side lift. When she recommissions in 1958-9 she may be the first R.N. carrier with a fully-angled deck.

Gerben Sonderman; Glen Lynes

IT is with great regret that we have to record the deaths, on the same day last week, of two well-known test pilots, one a Netherlander and the other a Canadian.

One was Lt-Col. Gerben Sonderman, Fokker chief test pilot.

JAVELIN FROM JAVELIN: This picture has more than one claim to attention. It is the first Javelin-to-Javelin air picture; it shows Javelin FAW.1 No. XA552 equipped with under-fuselage drop tanks; and it is a notably fine impression of the exhiliarating "wheels-off" moment in a formation take-off. Pilot of XA552 was F/L. Peter Varley. The photographic machine, XA567, was flown by W/C. R. F. Martin, the airfield was Gloster's main base at Moreton Valence, and the photographer (need we add?) was Russell Adams.



CANBERRA TO JAVELIN: One of the experimental Flight Refuelling contacts described in a news paragraph on this page.

He was killed in an accident on October 20th when flying an S.14 jet trainer at Hagerstown Airport, Maryland, U.S.A. The machine had been flown over on the previous day from La Guardia for a demonstration tour of several naval and military airfields, under the auspices of the Fairchild Engine and Airplane Corporation.

Gerben Sonderman was born on December 29th, 1908, at Drachten, Holland, and, having finished high school, he studied at the Academy for Physical Training. Following graduation he became a teacher at a high school and, after joining the Rotterdam Lloyd Shipping Company, was appointed a physical training instructor. Later he joined the Netherlands Air Force, thereby achieving a long-standing ambition.

In October 1936 he was appointed as a pilot officer in the Reserve. On January 23rd, 1939, he entered the service of the Fokker company as a test pilot, and tested the D.21, D.23 and G.1 fighters, as well as the T.5, T.8-W and T.9 bombers. During the German invasion he fought gallantly, in a G.1, against the Luftwaffe, and during the occupation was an active member of the resistance movement. After the war, in 1946-47, he was one of the few Dutch pilots to take the E.T.P.S. course in England. In January 1947 he was promoted 1st lieutenant and, in May 1948, captain. Thereafter he became personal pilot to His Royal Highness Prince Bernhard and to the Netherlands Royal Family. He was made a lieutenant-colonel in 1954.

A pilot of exceptional ability and wide experience, Sonderman was also a man of great personal distinction and charm. He was well known to *Flight* and had many other friends in this country. When the Editor wrote his "In the Air" on the S.14 last year he concluded: ". . . I also confirm my opinion that Capt. Sonderman is truly a royal pilot to fly with."

Col. Sonderman.

Glen Lynes.

The second pilot to lose his life on October 20th was Glendon Joseph Lynes, who was one of the two Avro Aircraft test pilots who demonstrated CF-100 fighters at the S.B.A.C. Display this year. Thirty-seven years old, he was killed when a CF-100 crashed in a field one mile south of Malton Airport, Ontario.

Glen Lynes started flying at 15 and shortly before the war came to Britain to join the R.A.F. In 1941 he was awarded his wings and was posted to a Defiant night fighter squadron. Later he flew Spitfires and Hudsons for Army Co-operation Command. In 1942 he was posted to a Spitfire squadron of the Desert Air Force, thereafter destroying two enemy aircraft and being credited with two probables before he was himself shot down by ground fire. He was taken prisoner and was moved successively to Italy and Germany, where he made three unsuccessful attempts to escape before succeeding, on a fourth attempt, in bluffing his way across Germany to reach the American spearhead at the Rhine.

He returned to Britain, rejoined a Spitfire squadron and for two years flew as a test pilot in the Air Fighting Development Squadron at the C.F.E. The R.A.F. then sent him to California for a year to participate in accelerated flight-tests of the F-84. Back in Britain, he was appointed a flight commander in No. 74 Squadron (Meteors) and was later engaged in trials of the Meteor 8 at the C.F.E. Before joining Avro Aircraft as a test pilot he flew Canadair Sabres and T-33s.

Flight-refuelling the Javelin

SECURED during recent trials, the photograph at the top of this page shows a Gloster Javelin all-weather fighter being refuelled from an English Electric Canberra B.2 equipped as an experimental tanker. Both machines have the probe-and-drogue equipment designed and produced by Flight Refuelling, Ltd., of Blandford, Dorset—equipment, be it noted, which has been developed from a system first used by Sir Alan Cobham for transferring fuel in the air 21 years ago.

The Javelin trials are the first to be undertaken with any British fighter aircraft of wholly post-war design. For the purpose of the tests the probe was mounted on the leading edge of the Javelin's starboard mainplane, but Flight Refuelling point out that it could alternatively be installed in the nose or in tip tanks or drop tanks. Pilot of the Javelin was Mr. Pat Hornidge, the Flight Refuelling test pilot, who, in 1949, remained airborne in a Meteor for more than twelve hours. Later the Javelin was flown by W/C. R. F. Martin, D.F.C., A.F.C., Gloster's chief test pilot, who made several contacts.

Flight Refuelling equipment is also destined for the Valiant Vulcan and Victor, and the makers claim that by means of their high-performance "packaged" equipment a V-bomber will become a V-tanker overnight.

Awards for Weather Reporting

AN award to two British airline pilots for their work in the reporting of *en route* weather conditions was made at Londonderry House last Monday. The officers were Capt. L. V. Messenger, O.B.E., and Capt. J. T. Percy, both of B.O.A.C., and the award (two handsome calf-skin brief-cases) was made on behalf of the Air Ministry by Sir Graham Sutton, C.B.E., D.Sc., F.R.S., Director of the Meteorological Office.

Capt. Messenger has served 28 years with B.O.A.C. and Imperial Airways, half of them on the Atlantic route, which he has crossed 500 times. Capt. Percy has been 23 years with the Corporation and Imperial Airways, and has made some 350 Atlantic crossings. A similar award will be made annually by the Air Ministry to officers of airline companies registered in the United Kingdom.

A Loss to the Industry

WE are sorry to learn of the death, on October 20th, of Mr. Ernest Wilfred Swales, deputy managing director of Automotive Products Co., Ltd., Borg and Beck Co., Ltd., and the Lockheed Hydraulic Brake Co., Ltd. He came from the Rudge Whitworth Cycle Co. in 1939 to join Lockheed, where during the war he was manager of the aircraft division. After the war he took a large part in the group's planning and reorganization for peace-time production.

Mr. E. W. Swales.

In January 1944 he was appointed executive director (production) of the Lockheed Hydraulic Brake Co. and was later made executive director (production) of Borg and Beck. In January 1954 he was appointed deputy managing director of Automotive Products, Borg and Beck and Lockheed, the three main subsidiary companies of the group. Mr. Swales, whose illness had been a protracted one, was 58 years of age. He leaves a widow and one son.

Pan American's 71-seat DC-7Bs are at present the most modern transports in service on the North Atlantic route.

BLUE RIBAND ROUTE

Atlantic Air Traffic Today and Tomorrow

By ROBERT J. BLACKBURN

EVERY twelve minutes, on average, a long-range airliner begins or ends a scheduled flight along the Atlantic airways linking Europe and North America. Every day the 15 airlines competing for traffic on this great international route are offering nearly 3,500 seats on some 60 first-class, tourist, or mixed-class services.

This permanent airlift, by reason of its regularity, and because it has developed so gradually over the post-war years, has never been a source of public wonder or acclaim. It nevertheless represents a major stage in the evolution of transport. The history of the North Atlantic airways is in large measure the history of long-distance air travel.

The momentous PanAm announcement of a £96 million order for jet transports makes it timely to review briefly the growth of North Atlantic air traffic to date, and to hint at the shape of things to come. Undoubtedly a revolution is in progress. Over the past year ten major transatlantic airlines have placed orders for 172 new transport aircraft destined primarily for North Atlantic service and having a total basic value, excluding spare parts, of well over £200 million.

Though this sum represents perhaps 20 per cent of the capital value of all the transport aircraft in scheduled airline service today, North Atlantic air traffic accounted for only about seven per cent of scheduled airline ton-miles performed in 1954. These figures stress the abnormally competitive nature of the route, a fact further emphasized by the multiplicity of carriers involved.

Regular, large-scale airline traffic between Europe and North America began in earnest nine years ago with the introduction of the first services by pressurized landplanes—Constellations, DC-6s and, later, Stratocruisers. These types, or their derivatives, are still carrying the vast majority of traffic and will continue to do so until the first of the new generation of turbine-powered transports appear at the end of this decade. The growth of air and sea traffic respectively over the past seven years is plotted in the following table, showing annual totals of passengers carried.

North Atlantic Passenger Traffic

	1948	1949	1950	1951	1952	1953	1954
Air	253,000	273,000	317,000	341,000	446,000	510,000	578,000
Sea	637,000	672,000	762,000	710,000	844,000	900,000	938,000

Probably the most significant trend shown by these figures is the overall traffic-increase of 70 per cent during this seven-year period. Between 1948 and 1954 the airlines increased their passenger carryings by 129 per cent, whereas ship traffic increased by some 47 per cent. However, it is important to note that ships are still carrying the greater share of the traffic (62 per cent last year), even though their share has decreased by 9 per cent since 1948.

The concern felt by shipping companies about the effects of increasing air competition is understandable and—from a long-term viewpoint, perhaps—justified. But some shipping spokesmen, in expressing such fears, tend to overlook the fact that their own traffic has increased by an average of nearly seven per cent in each of the past seven years, which appears a reasonable rate of growth for an established form of transport. Moreover, it is unlikely that the airlines alone have reaped all the benefits of the increased community of interest—and potential traffic—created by the establishment of regular over-night travel between the two continents.

Again, it may be noted that a high proportion of transatlantic air traffic represents a new market which the shipping companies, because of the low speed of their services, are incapable of tapping. The businessman making several quick transatlantic journeys per year is one obvious example of this new class of traffic. Another is the wage-earner who can afford the transatlantic fare but whose vacation period is limited to two or three weeks.

It seems reasonably certain that American tourists do in fact represent the largest single class of transatlantic air travellers today. It was not always so. In the immediate post-war years the fares of most passengers were paid by their employers, whether Governments or private companies. In 1948 traffic was stimulated by the large number of Europeans emigrating by air to North America, though the flow was one-way and resulted in a 20 per cent unbalance between westbound and eastbound traffic. A further stimulus to traffic was the devaluation of the pound, late in 1949, which brought the possibility of a 1950 summer holiday in Europe within the grasp of many thousands of North Americans.

By far the most important factor influencing the development of traffic on the North Atlantic route—and, indeed, on every other international route—was the introduction of the so-called "tourist" fare on May 1st, 1952. Passengers were for the first time offered a choice of second-class travel at an average rate of 30 per cent

All B.O.A.C.'s North Atlantic services are operated by Stratocruisers, still regarded by many travellers as the most comfortable on the route. The big Boeings also operate PanAm's first-class services.

Also a newcomer to the North Atlantic is the tip-tanked L.1049G, in service with Lufthansa, Air France and T.W.A.

below the first-class fare, provided that they were prepared to accept reduced standards of comfort and service.

This experiment was first tried on the North Atlantic and the results were sufficiently encouraging for it to be adopted on all remaining international routes within three years. Experience has shown—not surprisingly, perhaps—that, given equal safety standards, the majority of passengers will choose the cheaper service, and furthermore that the price of travel is far and away the most important influence on rate of traffic growth.

It is thus of interest to examine the North Atlantic air-fare structure as it has evolved over the post-war years. The most convenient unit of measurement is the single fare, in dollars, between London and New York, on which all other North Atlantic fares are based. The return fare, incidentally, is twice the single rate less 10 per cent. During the winter or "thrift" season, which extends from November 1st to March 31st, return fares are reduced by about four per cent, but no concession is allowed on single tickets. Reductions are offered to family parties travelling during the off-peak period, the head of the party paying the full rate and his companions £40 to £50 less for single tickets.

The history of the basic first-class fare, as determined at successive I.A.T.A. conferences, is as follows: July 1946, $375; October 1946, $325; April 1948, $350; November 1950, $375; April 1952, $395; April 1954, $400. At the latest I.A.T.A. conference, held last month in Miami, the airlines agreed on a 10 per cent increase, to $440, for the summer season beginning on April 1st, 1956. The dollar figures do not, of course, reflect the effect of devaluation in September 1949, when the price of a single ticket from London to New York increased from £86 17s to £125—though the "basic fare" remained unchanged at $350.

The basic tourist fare, introduced at $270 in 1952, has suffered fewer changes. In April 1953 it was increased to $275, and a further $15 was added in April 1954. Unlike the first-class fare, the basic tourist rate will remain at its present level of $290 during 1956.

Though these figures show an apparent trend towards increasing fares, it has to be remembered that the general level of costs and salaries—both within and outside the airlines—has increased at a greater rate. The airlines have, in effect, succeeded in steadily reducing seat-mile costs by a substantial margin over the past ten years, though the most efficient carriers now appear to have reached the limit of improvement with present-day equipment.

Ship fares vary considerably according to type of vessel and class of accommodation. However, the rates quoted above may be taken as representative; for comparison, current air fares are also quoted.

The introduction of second-class air travel on the North Atlantic was brought about largely by pressure from the United States flag carriers—Pan American and T.W.A. At one stage of the protracted inter-I.A.T.A. battles which preceded the announcement of the $270 fare PanAm threatened to leave the association and file an individual tariff with the governments concerned.

One-way fare: London-New York.

	Sea	Air*
First-class	$325 (£116)	$450 (£160 14s)
Cabin-class	$220 (£78 10s)	$400 (£152 18s)
Tourist-class	$160 (£57)	$290 (£103 12s)

*First-class air with sleeping berth ($50 extra) is taken as equivalent to first-class sea; the basic first-class air fare is compared with cabin-class sea travel.

In the event, differences were resolved and accord preserved. There is little doubt, however, that separate schools of thought survive behind the façade of I.A.T.A. unanimity. So far the American faction has forced the pace and pattern of re-equipment, fares, policy and traffic development. The reasons for this undeniable, if unpalatable, fact may be summarized as follows:

Resources: Two American flag carriers represent the largest and richest of the Western nations. European interests in the North Atlantic are divided between a dozen airlines.

Equipment: As yet, only three manufacturers—all American—have produced transatlantic airliners. The U.S. carriers are not only capable of placing larger and earlier orders than European customers, but possess the added advantage of nearness to the makers of airframes, engines and components.

Traffic: American carriers have traffic rights in all major

(*Concluded on page 697*)

The intensity of current operations on the North Atlantic route, as shown by the adjacent table, may come as a surprise even in aviation circles. The figures are for flights scheduled to take place last week, as published in the "A.B.C. World Airways Guide." They show that during this seven-day period 15 airlines had scheduled 427 crossings and offered over 24,000 seats—the majority at tourist rates. Average seating per aircraft was 56.

NORTH ATLANTIC TRAFFIC: A TYPICAL WEEK'S OPERATIONS

	No. of crossings	No. of seats	Aircraft	Service*	Seating	Cities served
Air France	20	1,108	L.1049G	2F	32	Paris, New York, Mexico City, Boston, Chicago.
				18M	24F 34T	
B.O.A.C.	38	2,458	S'cruiser	20F	50	London, Glasgow, Montreal, Chicago, New York, Boston.
				18T	81	
C.P.A.L.	2	112	DC-6B	2M	14F 42T	Amsterdam, Vancouver.
Deutsche Lufthansa	10	650	L.1049	10M	16F 49T	Hamburg, Dusseldorf, Frankfurt, New York.
El Al	6	390	L.049	6T	65	Tel-Aviv, Athens, Rome, Paris, London, New York.
Iberia	8	568	L.1049C	8M	31F 40T	Madrid, Azores, New York.
K.L.M.	28	1,470	DC-6B	4M	12F 48T	Amsterdam, Montreal, New York, Monterey, Mexico City, Curacao.
			DC-6	2M	22F 18T	
			L.1049C	6M	31F 25T	
			L.1049C	6F	39	
			L.749A	2F	46	
			L.749A	8T	61	
L.A.I.	9	—	DC-6B	7M	—	Rome, Milan, New York, Naples, Paris, Boston.
			DC-6	2F	—	
Loftleidir Icelandic Airways	10	—	DC-4	10T	—	Hamburg, Copenhagen, Gothenburg, Oslo, Stavanger, Reykjavik, New York.
P.A.W.A.	142	8,561	S'cruiser	32F	43	Chicago, London, New York, Lisbon, Dusseldorf, Paris, Oslo, Stockholm, Helsinki, Hamburg, Brussels, Amsterdam, Brussels, Manchester, New York.
			DC-6B	52M	18F 41T	
			DC-6B	22T	71	
			DC-7B	36T	71	
Sabena	12	666	DC-4C	2T	38	
			DC-6B	10M	12F 47T	
S.A.S.	28	1,806	DC-6B	8F	50	Stockholm, Copenhagen, Hamburg, Bremen, Glasgow, New York.
				2T	73	
				18M	16F 54T	
Swissair	14	812	DC-6B	14M	8F 50T	Zurich, Geneva, Frankfurt, New York.
T.C.A.	14	882	L.1049	14M	9F 54T	Toronto, Montreal, London, Dusseldorf.
T.W.A.	86	4,430	L.749A	2F	49	New York, London, Paris, Frankfurt, Geneva, Rome, Tel-Aviv, Zurich, Lisbon, Madrid, Algiers, Tunis, Milan, Rome.
				4F	18	
				20F	33	
				60T	60	

* Number, and type: F, first-class service; T, tourist-class service; M, mixed-class service.

HERE AND THERE

TREKKING SOUTH: This D.H. Heron for the South African Air Force is seen to leave Hatfield with a sister aircraft for the S.A.A.F. transport base at Swartkop, Pretoria.

Forty-six Decks

AN order has been placed by the French Air Ministry for twenty-three Bréguet Deux Ponts military transports bearing the designation Bréguet 765. Pratt and Whitney R-2800 CB-16 engines are specified. Pending delivery of these aircraft the French Air Force is operating three Bréguet 761 S machines for the training of aircrews and maintenance crews. The development of special internal arrangements is also going forward.

Non-stop to Aden

A CANBERRA of Bomber Command last Monday flew 3,320 miles from R.A.F. Station Wyton to Aden at an average speed of 492 m.p.h. Subject to confirmation, this is the first non-stop and fastest flight from the United Kingdom to Aden.

America's Wright Lecture

THE Wright Brothers Lecture of the Institute of the Aeronautical Sciences is to be given this year by Raymond L. Bisplinghoff, Professor of Aeronautical Engineering at the Massachusetts Institute of Technology. His paper, entitled *Some Structural and Aero-elastic Considerations of High-speed Flight*, will be given in Washington on December 17th; then, for the benefit of I.A.S. members in the West and mid-West, it will be repeated in Los Angeles on December 20th and in Cleveland on December 22nd.

Communist Conversion

PRAGUE radio reported last week that a number of Czechoslovak Air Force pilots were now undergoing conversion courses to the Ilyushin Il-28 twin-jet bomber. Earlier reports revealed that while some of the Il-28s had been flown in from the Soviet Union others were being assembled in Czechoslovakia from Russian-produced parts.

Mr. E. G. King

FLIGHT records with regret the death, at the age of 78, of Mr. Ernest Gerald King, chairman of the Louis Cassier Co., Ltd. A subsidiary of Associated Iliffe Press, the company publishes technical journals, among which are *Mechanical Handling*, *Machine Shop Magazine* and *Welding and Metal Fabrication*.

R.A.F. Comets and Seamews

TANK TESTS on a modified Comet 2 fuselage are now under way at Hatfield and a second modified aircraft is nearing completion. It is expected that delivery of a number of Comet 2s to the R.A.F. will begin early next year; they are to be used on a high-speed ferry service between England and Woomers. Early in the New Year, also, a Coastal Command squadron will receive the first Short Seamews, now coming off the production line at Belfast. Preliminary development of the aircraft is now complete.

To Mexico

MR. ALEX DUNCAN, who for the past 18 years has been with R. K. Dundas, Ltd., is retiring from the British company to form a Dundas-Duncan company in Mexico. He leaves with the best wishes of his many friends in the industry. Mr. Michael Taylor succeeds him in looking after the affairs of the aviation division.

W.J.A.C. Appointment

DURING the absence of Miss Freydis Leaf, chief aviation adviser of the Women's Junior Air Corps, on a six months' tour in South Africa, her duties will be taken over by Mrs. Joan Grimaldi. Since learning to fly after leaving the A.T.S. she has acted as a ferry pilot for a number of firms and flying clubs.

More Sabres for Turkey

IT was reported from Turkey last week that the Canadian Ambassador in Ankara, Mr. Herbert Moran, had said that Canada will be supplying Turkey, early next year, with sufficient jet fighters to equip a fourth group; she had already equipped three Turkish fighter groups with F-86 Sabres. Mr. Moran said that Turkey was being supplied with military equipment and materials under the Turkish-Canadian Mutual Assistance Programme put into effect in 1953.

Long-service Stewardesses

FROM Holland comes the suggestion that a K.L.M. stewardess, Rietje Kramer, is probably the first in the world to complete more than 10,000 hours in the air; but from the U.S.A. there is news that American Airlines' senior stewardess, Hazel E. White, has recently celebrated her twentieth year with the company, for whom she has flown more than 15,000 hours. Her first duties were on the sleeper service flown by Curtiss Condors between Los Angeles and Cleveland, Ohio.

Transistor Computor

THERMIONIC valves have been virtually eliminated in the design of an electronic computor which recently went "on steam" at the Atomic Energy Research Establishment, Harwell, Berks. Some 350 transistors (40 junction-type and nearly 300 point type) are employed, and the level of reliability is such that the new computor can be left to do night and week-end work without attention. Although having a relatively small working memory and a low pulse rate, the equipment compares favourably with much larger computors of conventional design. The machine was designed and built by the A.E.R.E., with N.P.L. assistance.

"BY THESE PRESENTS BE IT KNOWN—": For the edification of bears and walruses this helicopter crew from H.M.C.S. "Labrador" recorded their visit to an Arctic ice floe. The ship has been on DEWline duties in the eastern Arctic since mid-June.

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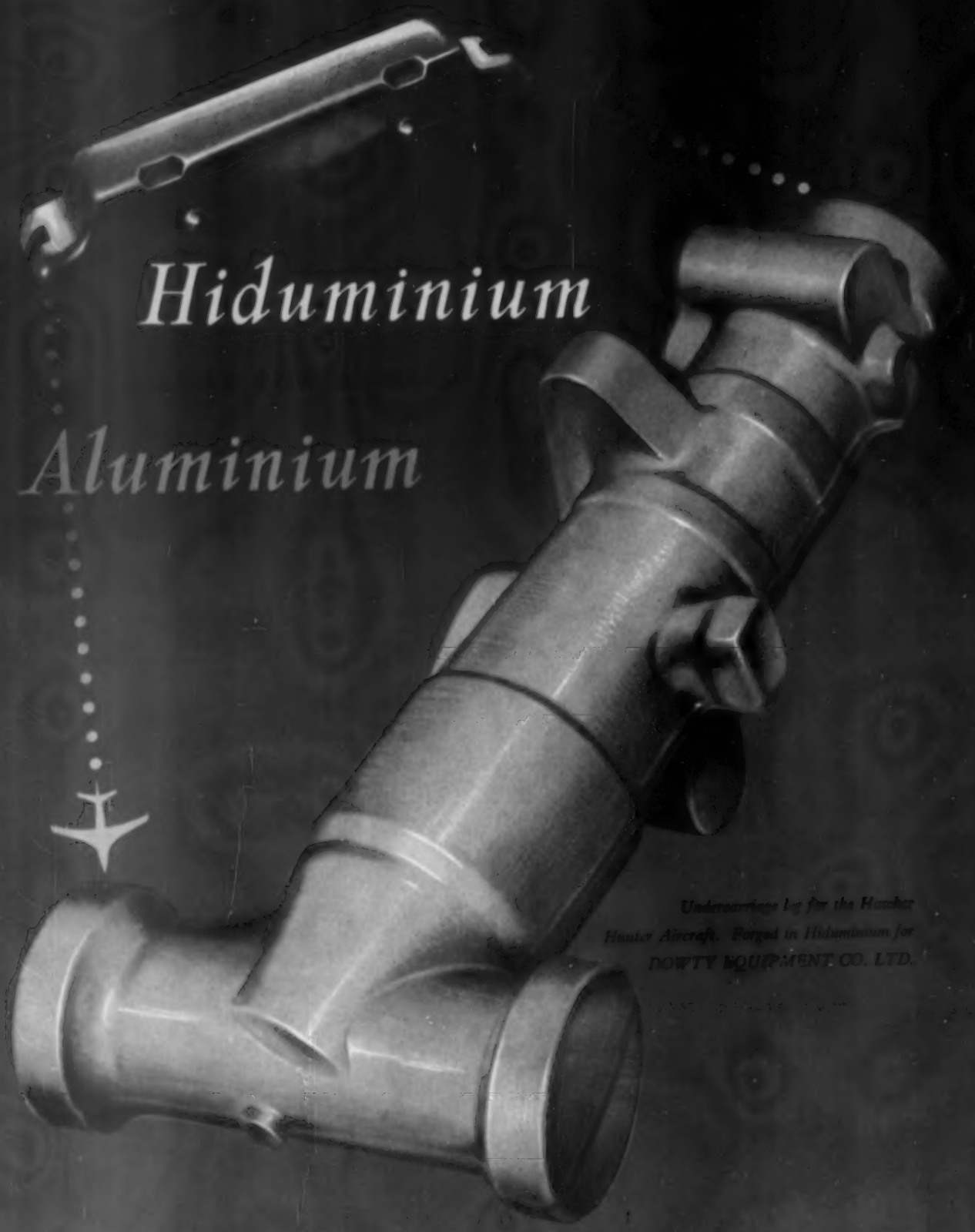

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HIGH DUTY ALLOYS LIMITED · SLOUGH · BUCKS

No. 100 SQUADRON

—receives its Standard: a Brief History of a Notable Bomber Unit Born in World War I

Illustrated mainly with "Flight" photographs

The Squadron's standard is of the latest pattern, with leeks and the new crown, but the grizzly skull-and-crossbones emblem dates back to the unit's very earliest days.

AT Wittering last Friday No. 100 Squadron, Bomber Command, received its Standard in recognition of more than 25 years' service. The unit was in fact formed in February 1917, when transport and personnel drawn from Home Defence Squadrons were assembled at Farnborough under Maj. M. G. Christie. In March the squadron moved to France and was established on April 1st at Izel le Hameau, together with No. 11 Sqn. who were flying F.E.s by daylight. No. 100 had been formed specifically as a night bomber unit, the first in the new Independent Air Force, as the nucleus of a strategic bomber force to be used against Germany. Its equipment was twelve F.E.2Bs and four B.E.2s. These machines were fitted in France to carry 25 lb and 112 lb bombs and provided with special night-flying equipment in the form of luminous instruments—compass, r.p.m. gauge, "aneroid" (altimeter), A.S.I. and watch.

Four days after reaching their new base, the F.E.s made their first bombing raid, with Richthofen's base at Douai as target. Richthofen himself described how the "lattice tails," using what was their standard technique, cut their engines and glided right down to the deck in the moonlight to drop their small H.E. bombs at roof-top height while Richthofen and his men fired at them with captured British machine guns mounted on stakes in the ground. Each time the explosion of the bomb would shake the aircraft as it climbed away at full bore.

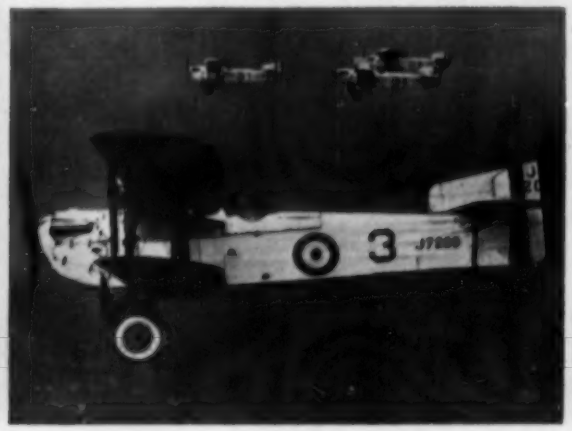
The method of attacking trains at night was to glide down with the engine completely cut, and open up for a slow run up the train. The bombs were then dropped in sticks along the train and a flare released afterwards to observe the results. These sorties were mainly carried out in bright moonlight; sometimes the aircraft were rapidly turned round and sent off for a second raid the same night.

Many curious adventures befell the crews in those days. One crew force-landed behind the German lines and walked back to the British side. Another landed in a snowstorm to find their bearings and warm themselves with a cup of coffee, only to find that the people who were coming to their assistance were Germans. They realized they were behind the German lines and made desperate and finally successful attempts to restart their engine and take off again, in pitch darkness. They took off towards their potential captors and came under close-range rifle fire just before getting airborne, but returned successfully to base. It was their second sortie over "Hunland."

In fact strategic bombing consisted mainly of supporting offensives, or hindering enemy troop movements by attacking his communications a short distance behind his front line. There is little record of the equipment actually used for aiming bombs, but it seems to have been the general rule to get so low that they could not miss. Even so, it was considered a pity to carry only three of the larger bombs, since this gave so few attempts in which to hit the target. After bombing it was general to fly low again and strafe opportunity targets with the machine gun in the nose.

On August 13th, 1918, the squadron took over its first Handley Page O/400 twin-engined bomber in return for two of its F.E.s, and the organization changed to allow for two flights of five H.P.s each instead of three flights of six F.E.s each. The F.E.s' raids had had a considerable effect on the battles which had been fought in 1917 and great damage had been caused. But throughout the year the new bases for the large bombers which were to fly deep

This F.E.2B is representative of the first equipment used by No. 100 Sqn. when it was the first night bomber unit of the Independent Air Force in France in 1917. It is not known exactly where this picture was taken. Right, the Fairey Fawn, with which the squadron was equipped in 1924 at Eastchurch. These aircraft were eventually exchanged for Hawker Horsley torpedo bombers in 1930.



Tremendous progress in aerodynamic design is clearly shown by the views of the squadron's Vildebeests over Malaya in about 1935 (left) and of its Canberra B.2s over East Anglia, taken specially by "Flight's" photographer this month. The original flag from which the squadron took its badge is shown below. This flag finally perished of old age while in the hands of the squadron adjutant in a Japanese prison camp during World War 2.

No. 100 SQUADRON . . .

into Germany had been under construction, and with the arrival of the first O/400 the squadron was really ready to begin the task for which it had first been formed. It had already established a great reputation for itself and had received congratulatory messages from field commanders on several occasions.

Some raids on towns in Germany proper had already been carried out, in retaliation for indiscriminate German raids on English towns, but it was when the Handley Pages arrived that action was carried well into Germany. Because of this the enemy was forced to divert considerable formations of guns and aircraft to rear areas for local defence. Other night actions were instrumental in keeping the enemy's own night bomber force from becoming anything approaching a menace. Particular instances of the squadron's success in night bombing are the raids on the Hagendingen steel works on the night of July 16th-17th, 1918, when a hit on the central blowing station put the works out of action for some time; and on chemical works at Saaralben on August 22nd-23rd, when extensive damage was caused.

Among the industrial towns in Germany which the squadron raided were Frankfort, Mannheim, Offenberg, Kaiserslautern, Karlsruhe, Saarbruecken, Ehrange and Trier. The battle honours gained are Vimy, April 1917, Arras, April-May 1917, Messines, June 1917, 3rd battle of Ypres and Passchendaele, July-October 1917, Amiens, April 1918, St. Mihiel, September 1918 and Argonne, October-November 1918. Sorties numbered 213, 185 tons of bombs were dropped and 450,000 rounds of ammunition fired in raids by up to six aircraft at a time. Five enemy aircraft were brought down and probably destroyed.

Lord Trenchard, then Maj-Gen. Sir Hugh Trenchard, G.O.C. Independent Air Force, wrote to the squadron commander, Maj. C. G. Burge, shortly after the war:—

"I would like to let you know what I think of No. 100 Squadron, the first complete night-flying squadron that was sent to the Western Front.

"It started with a splendid name and within a few weeks I was counting on it as one of my best weapons for hitting the enemy . . . In 1918 it still kept up its great name and was one of the quickest squadrons I have ever had under my command at learning new-type machines when it was re-equipped with Handley-Pages.

"I can only say that it was one of 'the great squadrons' of the war, and I was very proud to have had the honour of commanding such an efficient squadron."

In an earlier message Lord Trenchard had said that he would always be pleased to see or hear from any members of the squadron and, remembering this, the present commander, S/L. C. P. H. Kunkler, wrote inviting him to attend the Standard presentation. Regretting that he was unable to accept, Lord Trenchard replied, "I look upon No. 100 Squadron almost as one I have been in myself. I seem to have been connected with the Squadron most of my Service life and I always remember the good work done by members of it."

After World War I the squadron is variously recorded as being "practically non-existent" and "disbanded"; but notice soon came through that it was to be reformed as one of the permanent squadrons of the peace-time R.A.F. In fact, in February 1920, after languishing as a cadre squadron, it was reformed at Baldonnel, Co. Dublin, under the command of Maj. F. Sowrey and equipped with Bristol Fighters, which it flew against the Sinn Fein. In March it was designated No. 100 Bomber Squadron and in 1922 it flew to Spittlegate, Grantham, and converted to D.H.9As. It

The task of arming-up has changed relatively little between Horsley (left) and Canberra (right), except that the Canberra must be tilted to receive its clutches of flip-out finned streamlined 1,000lb bombs. The Horsley is at Donibristle, the Canberra at Wittering.

was then used as a training unit for officers who had been axed from the Army and Navy and had received short-service commissions in the R.A.F. 1924 saw a further conversion, to Fairey Fawns, and a move to Eastchurch. It was in the 1925 Hendon Air Display that No. 100 led the formation of four bomber squadrons which so impressed the crowds. During the General Strike of 1926 No. 100 distributed mail and newspapers both by road and air—a public service it was to emulate in 1953, when it photographed the flooded areas of Lincolnshire to show the extent of damage after the serious floods.

The next move was to Bicester airfield, then newly completed, in 1928; and it was during the stay here that the squadron had the task of evaluating the Avro Antelope, unsuccessful competitor of the Hawker Hart.

On November 3rd, 1930, the squadron moved to Donibristle and there began the operational task which was to lead nine years later to its virtual annihilation at the hands of the Japanese. Here also began the association with No. 36 Sqn. which was to end in that same gallant but tragic episode. It is recorded that Naval vessels leaving the Firth of Forth at that time had to run the gauntlet of the two squadrons' dummy torpedoes, launched from their Hawker Horsleys, and that many "kills" were claimed by both sides. Donibristle, in a *Flight* report of August, 1932, is defined as a "picturesquely situated aerodrome," but the report goes on to say that picturesqueness and happy landings did not "accord too well together." There was a "charming wooded hill" which, however, produced unpleasant air currents, and the ruts made by Horsley tail-skids could make the use of wheel brakes tricky. Donibristle, commanded by W/C. G. S. M. Insall, V.C., M.C., was nevertheless an ideal coast defence station; but new developments were already afoot, and that summer the first of the squadron's new Vickers Vildebeests (Bristol Pegasus) arrived.

Both No. 100 and No. 36 Sqns. were converted, but No. 100, while remaining part of Home Defence, was lent to Far East Command and went, in September 1933, to Singapore. The outbreak of World War II found both No. 100 and No. 36 still at Seletar, and still equipped with Vildebeests. In September 1941 an O.T.U. was established by A.H.Q. Malaya, to convert pilots of the two squadrons to fly twin-engined aircraft in preparation for re-equipment with Australian-built Bristol Beauforts; but conversion was not completed before the two units were withdrawn to Java. Both squadrons were then operating mainly from Seletar, according to one report, with Vildebeests and Vincents of mixed marks. Some of the Vildebeests had Pegasus engines while some, Mk 4s, had the cowled Perseus and some of these again retained wheel-spats. Most of the aircraft were painted yellow all over and operated at night. On this type of operation they lost not a single crew.

On December 24th, 1941, torpedo bomber squadron strength in Malaya is officially stated to have been No. 100 Sqn. with 13 Vildebeests, No. 36 Sqn. with 16 Vildebeests and one Naval flight of five Albacores, all based at Seletar. It was on January 26th, when the squadron had already been operating all night, that an

The Horsleys' torpedo playground was the Firth of Forth, close to Donibristle, where a "Flight" camera caught them (centre) in 1932. Now based at Wittering, Hunts., the squadron's Canberras posed in similar scenery over the shores of the Wash (left).

In the old days . . . by the tail of a Horsley at Donibristle, (l. to r.) P/O. V. P. J. G. Doherty, P/O. G. L. C. Jenkins, W/C. G. S. M. Insall, V.C., M.C., Station Commander, F/L. R. Jones, F/L. G. V. T. Thomson, F/O. C. E. Morse, F/O. C. E. Spencer.

No. 100 SQUADRON . . .

Australian Hudson reported two cruisers, 11 destroyers and two 10,000-ton transports, accompanied by barges, ten miles off the coast, heading for Endau. Japanese fighters based at Kuantan, formerly occupied by No. 100 Sqn., were providing air cover for this fleet. The forces available for opposing them were 21 Vildebeests and three Albacores of Nos. 100 and 36 Sqns. and nine Hudsons of Nos. 1 and 8 (GR) Sqns., R.A.A.F.

The attack was therefore mounted in two waves, the first of nine Hudsons and 12 Vildebeests escorted by 15 Buffaloes and eight Hurricanes, and the second of three Albacores and nine Vildebeests escorted by four Buffaloes and eight Hurricanes. Because of the previous night's activities the torpedo bombers were not able to set out until the afternoon and were thus committed to a daylight attack in the face of plentiful fighter cover from Japanese Navy Zero fighters.

The present chaplain-in-chief of the R.A.F., Canon A. S. Giles, who consecrated the Standard last Friday, was with the squadrons at the time and has recently written to S/L. Kunkler: "I saw the squadron setting out on that last raid on Endau, in which they were practically obliterated. Their actions were more than the ordinary fulfilment of duty; for flying Vildebeest aircraft on a daylight raid, they knew that they had little chance of coming through unscathed. As I spoke to many of them before they set off, I knew a good deal of their own feelings: their gallantry, therefore, to me is a very real thing . . ." In the attack the first wave was able to make some use of cloud cover and pressed home its attack; for the loss of five Vildebeests they claimed one cruiser and two destroyers sunk, both transports hit and one set on fire and casualties among troops on shore and in the barges. The second wave was less fortunate and, being exposed by clear weather, were intercepted before they reached the target. Six Vildebeests and two Albacores were shot down and other aircraft damaged and crews wounded. Twelve Zeros were shot down.

Altogether Nos. 100 and 36 Sqns. lost more than half their aircraft in this action and both their commanding officers, S/L.s R. F. C. Markham and I. T. B. Rowland. The remaining aircraft were badly shot up and many men wounded. Both units were therefore withdrawn to Java three days later, so that they could be reorganized. Under S/L. J. T. Wilkins the remnant as a composite unit was finally established at Tjikampek in Java and was there joined by the ground crews on February 15th. They continued operating, now at night again, and sustained further losses, S/L. Wilkins failing to return from one operation. Finally the last two Vildebeests took off to try to fly as far as possible along the island of Sumatra. When they ran out of fuel they ditched off Bencoolen, hoping to get ashore and find some craft to take them on to Ceylon. Unfortunately they had ditched within reach of the Japanese, and were taken prisoner. At about this time one Vildebeest is said to have carried no fewer than 18 people simultaneously in an evacuation flight.

Though the official dispatches speak of the amalgamation of Nos. 100 and 36 Sqns. into one unit in Java, some sources hold that No. 100 was in fact disbanded after the Endau raid and returned to Australia with the six Beauforts which had reached them in Malaya only shortly before the fatal raid. There had been so little time for conversion that only one Beaufort sortie had been flown, by S/L. P. Mitchell, who is now stationed at Kinloss. It must have been the intention to reform No. 100 with Beauforts in Australia, but official records next record the squadron as being reformed with Lancasters in England.

Up till this time the squadron had had in its possession a hand-painted flag bearing the skull and crossbones which had been their emblem since the days of the F.E.2B on the Western Front. Except for one deviation in the form of a bulldog, this had been their emblem all the time. The motto on the flag was "Blood and brains," but under the badge of the bulldog, seen on the fin of a Horsley at Donibristle, were the words "*nemo me impune lacessit*"—no one provokes me with impunity. This is in fact the motto of the Order of the Thistle, and was a Scottish association probably inspired by the squadron's location at the time. By the style of painting on the Horsley fin this seems to have been the official badge and motto at the time. Soon afterwards, however, the badge reverted once more to the skull and crossbones and, after a rather obscure incident, the motto became "*Sarang tebuan jangan dijolok*," a Malay phrase which has been variously interpreted as the admonitory "do not stir up the hornets' nest" or the instruction "do not just stir up the hornets' nest," with the implication that it would strike back unless completely wiped out. In the first interpretation the hornets' nest refers to No. 100 Sqn. while in the second it refers perhaps to a possible enemy. The reason for the temporary adoption of the bulldog emblem is not clearly explained.

Now . . . by the tail of a Canberra at Wittering, (l. to r.) F/O. G. J. Skermer, F/L. G. M. Bailey, "A" Flight Commander, F/L. W. H. Miller, F/L. G. Wilson, adjutant, S/L. C. P. H. Kunkler, squadron commander, W/C. R. C. Cobbe, acting station commander, and F/O. H. W. Ellerbeck.

The original flag mentioned above was kept by the squadron right up to the time of its dissolution in Malaya, at which time it was in the possession of F/L. E. Trillwood, the adjutant. He was taken prisoner, but kept the flag with him throughout his captivity until, through wear and tear and climate, it fell apart and had to be discarded. The flag-pole was nevertheless preserved and brought out of captivity to the transit camp at San Francisco, where F/L. Trillwood waited for repatriation in October 1945. But there it too had to be abandoned since there was not room on the transport provided to take it any farther. Photographs of it still exist, however, and one is reproduced on p. 674.

It is not known whether any of the personnel from Singapore joined the squadron on its reformation in England, but the records have it that No. 100 once more joined the conflict in the first part of 1943 as a Lancaster unit with Bomber Command in England. From then until March 1945 it operated from Waltham and built up a close friendship with the townspeople. Its first sortie was with eight Lancasters against the U-boat pens at St. Nazaire on March 4th, 1943. Targets soon afterwards included Nüremberg, Northern Italy and Pilsen, all long-range raids; and by the end of the year the unit held second place in its group for the number of successful sorties completed, and had the lowest losses. The Commander was then W/C. R. V. McIntyre.

During 1944 eighteen raids were made on Berlin, and on one occasion an aircraft collided with a German night fighter and returned minus six feet of wing, but with some pieces of the fighter still embedded in the airframe. On another occasion P/O. Booth was caught by a Me410 while on a mining sortie. He dived for 14,000ft with 410 m.p.h. on the A.S.I. The trimmers jammed and the stick loads were relieved by tieing some Mae West cords round the stick and lashing them to the pilot's seat-stay. Another Lancaster got back from the marshalling yards at Vierzon without ailerons. In fact the squadron was in the thick of actions in support of all the major military operations of those years. When hostilities ceased the unit was employed dropping supplies in Holland and returning P.o.Ws. from the Continent.

In the summer of 1946 the squadron was re-equipped with Lincolns and was ready to settle down to a peace-time rôle, but by 1950 their active services were once more required and they

(concluded at foot of page 678)

The heart of a good helicopter

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THE HELICOPTER'S FUTURE

—*in Great Britain: a Forecast*

By J. SHAPIRO

THIS is the text—slightly abbreviated—of a talk given by Mr. Shapiro at the recent Manchester conference of the Aerodrome Owners' Association. The author, who is a consulting engineer, is well known as a helicopter protagonist; he was, until 1951, chief technical officer of the Cierva Autogiro Co., Ltd.

IN this age, when continuous progress is expected of all engineering devices, including transport equipment, we can trace a certain recurrent sequence whenever a new development is initiated.

The first stage sees the birth of the idea and its growth into an all-embracing dream unfettered by the limitations of reality. This stage splits the world into dreamers and sceptics. In the second stage, engineering development has reduced the idea to practice. Indeed, "reduced" is the word, because the practical embodiment now appears with all its imperfections and immediately splits its own advocates into two opposing schools of thought—those determined to await improvement sufficient to support the original dream and those equally determined to sell the new device at all costs.

The champions of the second school of thought usually like to call themselves practical and regard the followers of the first, with some disrespect, as the theorists or perfectionists. Perhaps it is permissible to apply to these two approaches the somewhat outmoded designations of natural philosophy and natural history. The natural philosophers consider the broad foundations of the new development and endeavour to write a programme for its rational advance. The natural historians study the behaviour of the new animal and describe its appropriate but limited field of action.

The helicopter is today in this, its second, stage. Nevertheless, in any audience, however well-informed, all four attitudes are still to be found, the dreamers and doubters of the first stage and the philosophers and naturalists of the second.

The helicopter has become entrenched in various branches of human activity. The world is no more thinkable without helicopters than without fire-engines or lifeboats. Already, many efforts are being made to introduce helicopters into transport operations. Yet any attempt to argue the merit of the transport helicopter in its present stage is futile unless such use is supported by exceptional circumstances or by considerations which project beyond the present.

Let there be no mistake about it: the future of the transport helicopter belongs to a third stage. The third stage is not a mere multiplication of the reality known to us in the second stage. It is somewhere near the drawing-board, a little before or a little after the blueprint stage.

The potentialities of the third stage have been painted often enough before those who have taken the trouble to look at the picture. Maps and other details have been published showing the network of helicopter services which may reasonably be envisaged in Great Britain and other parts of north-west Europe similarly placed in density of population and in the existence of urban centres in close proximity to each other. We can achieve a state wherein a decisive improvement in communications between cities for passengers and express goods is reached at a cost of present-day surface transport. Moreover, just as it was the natural task of the United States to create in the 'thirties the air transport industry as we know it today, because their country with its typical distances is ideally suited for this vehicle, so it is the obvious task of this country to create, 25 years later, the helicopter transport industry—a challenge already eloquently expressed by R. Hafner of the Bristol Aeroplane Company.

Elsewhere I have had the opportunity to support this prospect of the future with technical and economic argument and to draw some of its details proceeding from the broadest statements of social and economic facts that can hardly be disputed. In the middle of the twentieth century, the air as a medium of locomotion promises to yield a revolutionary improvement of communication in speed, in comfort, in disregard of natural obstacles and in a reduction of capital investment. Vertical-flight machines can bring these benefits to short-haul transport, especially transport between cities. Precisely because the short-haul market is very much larger and more important in everyday life than the long-haul market it is both more necessary and more likely that its cost structure be brought down to the non-luxury level.

Such is the potential future of helicopters in Great Britain, a future which constitutes a profound change—as thorough, exciting and, I believe, desirable as that of any other revolution in transport in the history of this country. To bring this future about will need many bridges over many obstacles. My purpose now is to deal with the obstacles of public understanding which fashions the public will.

Those obstacles of understanding can be summarized with reference to the three stages of development mentioned earlier. First, all of us must be made aware of the fact that the second stage really has been reached. This is a step in the argument wherein I find the perfectionist school of thought most confusing and misleading. At this point all emphasis must be on existence and not on the promise of something better round the corner or, worse still, round several corners. In this matter we in this country must with some sense of envy look towards the United States.

When I talk of existence, I talk of a reliable existence and of a safe existence. Whether or not such an existence is established can only be found from long and varied experience. This duration and variety have now been reached across the Atlantic. There are helicopter types which have accumulated more than a million operational flying hours. There are individual machines which have exceeded the 8,000-hour mark.

In short, we must, if we do not close our eyes to reality, accept the existence of the helicopter and the advent of the rotating wing as a safe element in the armoury of aeronautical locomotion. At this point the question "why *have* rotating wings?" is no longer in tune with the times. We must, if necessary ask, "why *not* have rotating wings?" From this point onwards I cease to sympathize wholly with the helicopter existentialists.

The next question that demands an answer is how to bring about the third stage. Not until we know how to get there shall we judge the likelihood of the future here envisaged. The mere contemplation of the helicopter as it exists today will never bring this future about.

The answer which is heard most often is a set of demands of what the helicopter or its facilities should do and a variety of promises of what it shall do if only such and such a doctrine were followed in its conception.

The layman, even one who is intimately concerned with the planning of air communications, is often unable to follow the intricacies of engineering development. He may easily despair of sound judgment if he is left with the choice of either forming his opinion by studying the existing but clearly inadequate implement, or by following the disputes between squabbling technicians.

The technician may be tempted to appeal to the hidden engineering instincts which, to judge by the clientele of toy train manufacturers, lurk behind the innocent façades of most grown-ups. I shall endeavour to resist this temptation and so have no intention of selling to you my real helicopter of the future (with contra-oscillating superjet atomic rotor, electronically controlled and plastically supported), just to make sure that I get in all the best-advertised slogans of our age before anybody else.

There is an appeal (which, earlier on, I have called natural philosophy) that speaks a valid language even when it crosses the boundary between professions.

There is not the time here to go over the ground covered by the chain of reasoning which leads to a broad picture of the flying

"Yet any attempt to argue the merit of the transport helicopter in its present stage is futile unless such use is supported by exceptional circumstances or by considerations which project beyond the present."

"Flight" photograph

THE HELICOPTER'S FUTURE . . .

stock, the ground facilities and the ancillary equipment. The picture is clear enough to define the limits of endeavour between helicopter constructors, site-planners and architects, and instrumentation makers, without prescribing more than the general outline for each component of this picture.

Thus, there is no need to become committed to any particular engineering doctrine of helicopter design. It is certain that we need helicopters which are safer than any one of their power units —in other words, we need multi-engined helicopters—but the nature of the power unit is still open, and there is no cause to "freeze" the number of rotors. It is certain that the helicopter must be able to cruise at 150 m.p.h., but we cannot foretell whether the pure helicopter or some adaptation thereof will be the final formula. Whilst these two premises are generally accepted, the discussion on the best size is still raging. There is no doubt that within the current fashion of airline thinking the 60- or even 90-seater shows advantages over the 20- or 30-seater, but I must here quarrel with the current fashion of airline thinking. I consider it is time that somebody starts real rotorline thinking.

The airline trend is now a customary one, but, I submit, is only one avenue towards reasonable cost. It starts from the assumption that the total cost of passenger services is somewhere around 70 to 100 per cent above the flying cost. If so, the "giant way" may be the only way to achieve economical air transport. I believe there is another avenue, which starts from the other end, and it is that other way, which is characteristically the rotorline way. What type of flying and site facilities could be so blended into the natural environment of cities that the total cost of services is only marginally above the cost of flying? What consequences has the acceptance of this pattern on the properties of the desired flying machine, and its instrumentation?

This helicopter will have certain dimensions which it will not exceed because it will not be allowed to exceed them, just as neither trains nor buses have changed their tracks for generations, since we cannot alter our streets and stations every time we find a different optimum on an economic graph. Such helicopters will be able to operate from roof sites narrow enough for natural light underneath them.

They will be capable of vertical or nearly vertical operation into and out of the heart of cities. Helicopter services will be run much on the lines of local services, their stations will be made for fast turn-round like tube stations. Their frequency will be much greater than the duration of their journey. All this will be possible because the turn-round cost of heli-buses will be a small fraction of that envisaged today.

The desired complete system of engineering equipment which includes the helicopter, its operational facilities and its instrumentation cannot be brought about by studying the merits and weaknesses of existing helicopters, and their existing equipment. However, the imaginative creation which is necessary to attain the future stage will not be achieved without the progressive experience that can be acquired only through the constant use of present-day machinery.

The situation appears to contain an essential conflict between the present and the future, and a conflict which may lead to inaction. On closer study we shall soon discover that the broad approach which I have tried to follow does in fact embrace the solution of the apparent contradiction.

Indeed, if we have to assume that the future will be here when some particular engineering scheme has reached maturity, such as multi-rotor instead of single-rotor helicopters, or jet instead of shaft drive, or 50 instead of 25 passengers, then the best course for us to pursue is to wait until it has happened. What the aerodrome owner and the town planner must fear above all is the design of a facility and its construction in a congested area which will too soon become obsolete. Aerodrome owners are only too familiar with the continuous lengthening of runways and increase in runway load which has made once busy centres of aviation into deserted backwaters.

The proposition I am advancing in this talk amounts to saying that there is no likelihood of this happening with vertical aviation —which, today, means with helicopters. The conclusion from my trend of thought is startlingly simple. If we now reserve ground sites for the operation of present-day helicopters (with all their imperfections) we shall create the space for the operation, on the same plot, of future helicopters from roof sites; we shall be without fear of running out of space, so long as it remains our aim to make helicopters serve our cities and not to make our cities serve helicopters.

In other words, vertical flight is not a repetition of fixed-wing development, starting modestly but steadily moving towards monster planes and monster installations. It is a totally new trend of development moving in the opposite direction. Every valid step will be in the sense of requiring less space and fewer installations to bring more frequent and cheaper services into the heart of cities.

Today, perhaps, the existing helicopter is only marginally (though already decisively) better than the high-lift aeroplane. But the mode of vertical flight of which the helicopter is the only existing (and remains the only promising) representative in civil aviation contains all the potentialities of the future within foreseeable time. Facilities reserved for its present embodiment in the simplest possible manner are not likely to be outgrown in the course of the period whilst contemporary small inadequate helicopters, operated timidly with inadequate aids, gradually become future large adequate helicopters operated boldly with adequate aids.

In undertaking to discuss the future for helicopters in Great Britain, I do not presume to possess the powers of clairvoyance. My prophecy lies somewhere between possibility and likelihood. In a matter so closely linked with advance planning the future will be what we make it.

No. 100 SQUADRON (cont. from page 676)

flew to Malaya in May to begin anti-bandit strikes. Between May and December, when they came back to England, they flew over 100 strikes and dropped over 2,000 tons of bombs on jungle targets. And these were not without established success, for reports came through that an attack in the Mersing area during September had resulted in 30-36 bandits being killed and 19 wounded. Training continued at the same time, however, and as a strange repetition of an earlier rôle, F/O. Whitbread on August 11th, made some dummy torpedo attacks on the cruiser *Ceylon* off Singapore.

After this the normal round in England went on once again, broken at intervals with some interesting flights and detachments. At the time of the Egyptian revolution in July 1952 the squadron was sent to Shallufa in the Canal Zone for three months, and records show that various flights to North Africa, Norway and other points were interspersed in the normal routine of continuation training.

When the Mau Mau trouble broke out in Kenya, No. 100 was again called for; "A" Flight was detached to Eastleigh, Nairobi, and during a short stay there flew 53 strikes against hides in the jungle. These attacks are known to have caused considerable casualties and to have been instrumental in breaking up the large gangs into small, ill-organized groups.

Just as No. 100 was a little late on the scene with Lancasters, through no fault of its own, so it was not until April 1954 that it received its first Canberra B.2. In July it was visited by the Duke of Edinburgh and in the same month it became operational with the new aircraft. Since that time No. 100 Sqn. has returned to normal peace-time training flying, enlivened at intervals with some trials work. Now based at Wittering, Huntingdonshire, it is on the scene of the first Valiant operations and doubtless ready as ever to play its part in the new Bomber Command. C.M.L.

MORE OF THE "MATTRESS"

IT is understood that the M.L. Aviation Co. are constructing more development prototypes of their inflatable-wing utility aircraft (described in *Flight* of August 19th, page 246). Drawings of the developed aircraft reveal that the central fin, formerly fitted to the centre section of the wing, has been discarded. It is believed also that the pneumatic type of construction may be applied also to the nacelle, so that the entire aircraft (with the exception of the engine installation) will be inflatable. The M.L. company state that their main pre-occupation at present is with commercial application of the aircraft, one development being designed for agricultural use.

JOHN WILLIAM MASSEY

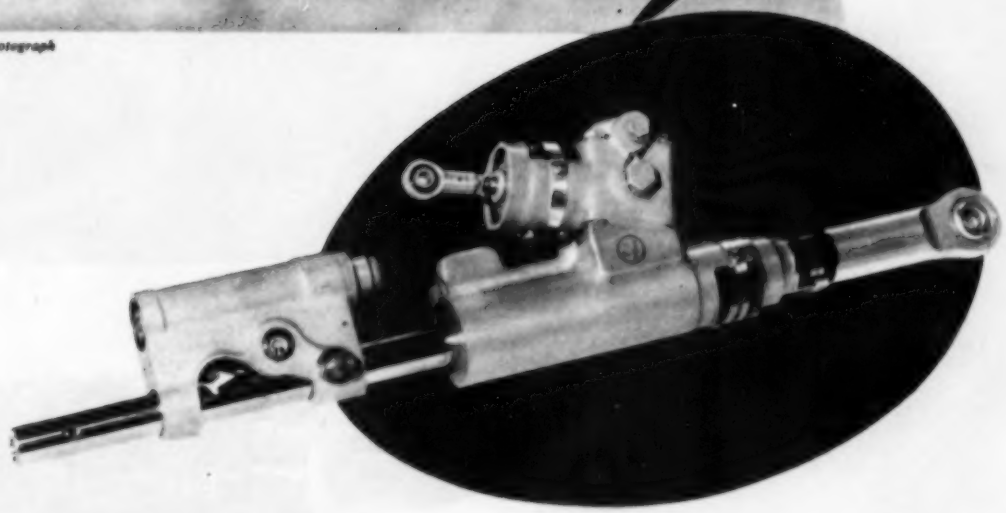
WE regret to learn of the death—recently, at his home in Surrey —of Mr. J. W. Massey. A founder-member of Brooklands Aviation, Ltd., he had been managing director of the company for over 20 years. After service in R.N.A.S. during the First World War, Mr. Massey entered in civil aviation the hard way, through joy riding, as did so many of his contemporaries. In 1928 he joined Duncan Davis on the founding of Brooklands Aviation, Ltd., and through the years that followed the successful Brooklands group of flying clubs was built up.

Concentrating his interests on the technical side, J. W. Massey built up the maintenance side, which later grew into the repair organization that handled over 2,000 Wellingtons during the Second World War.

By nature shy and retiring, he was seldom in the limelight; it was, however, his considerable practical experience together with his administrative ability that earned him the respect of his many friends in aviation.

"*FLIGHT*" Photograph

flying to fine limits



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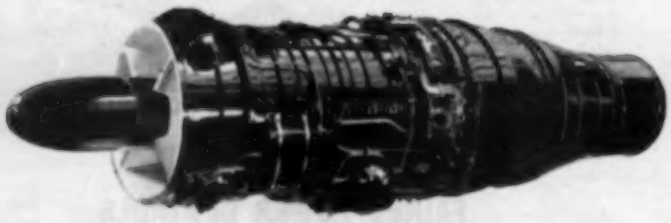

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Landing after its first flight is the North American T-28C trainer for the U.S. Navy. Changes incorporated in this model are the fitting of an arrester hook and barrier gear. More than 3,000 T-28s have now been delivered to the U.S.A.F. and Navy, production having been on schedule for 50 months.

AIRCRAFT INTELLIGENCE

U.S.A.

North American Research Aircraft. It has been decided that North American Aviation Inc. shall build a rocket-powered piloted research aircraft for exploratory flying at heights above 100 miles (520,000ft). The project is a continuation of the joint U.S.A.F. / Navy / N.A.C.A. programme which has hitherto principally involved machines built by Bell and Douglas.

"Century Series" Fighters. Already scheduled for the Lockheed F-104 air superiority fighter and the Convair B-58 Hustler supersonic bomber, the General Electric J79 turbojet, which delivers a thrust of the order of 15,000 lb without reheat, is under consideration for a number of types of U.S.A.F. and Navy fighters. Among these is the McDonnell F-101 Voodoo twin-engined fighter.

U.S.A.F. Bombers. General Nathan F. Twining, Chief of Staff of the U.S.A.F., said recently that though Russia had more fighters than America and that in performance these compared favourably with the U.S. machines, and though Russia outnumbered America in light jet bombers, the United States had "many times more B-47s" than the U.S.S.R. had Badgers. In the heavy bomber field America and Russia were about equal. Of the B-36 (once bitterly criticized by the U.S. Navy) General Twining said, "Perhaps more than any other factor the B-36 has kept us from being attacked."

France

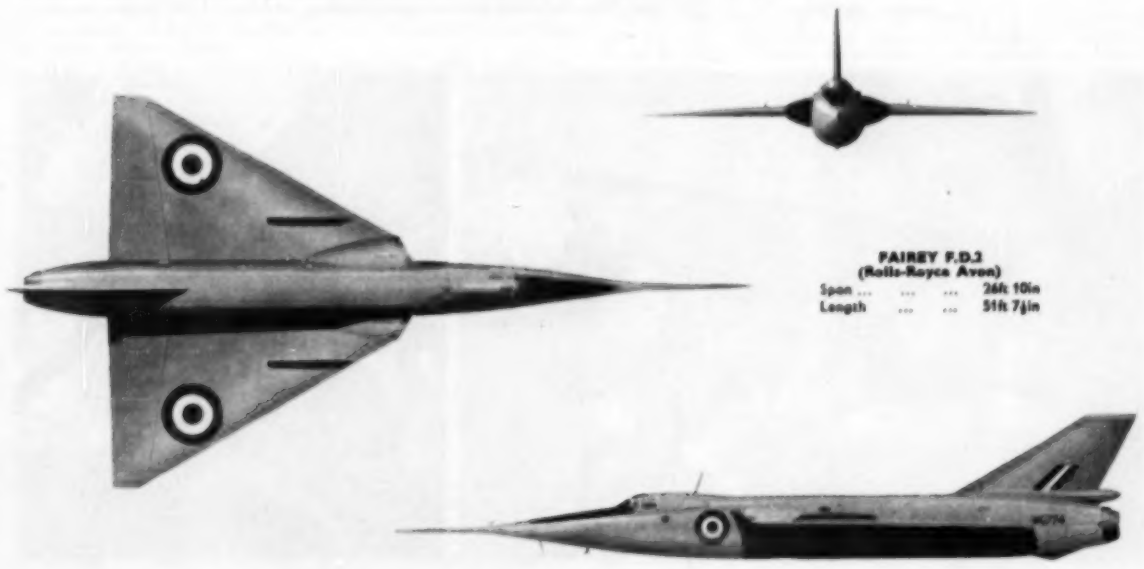
S.N.C.A.S.E. 210 *Caravelle.* Testing of this twin-Avon transport goes ahead at a fast rate, and it is generally considered in France that a large market is promised. M. Georges Hereil, president of S.N.C.A.S.E., has been visiting Rolls-Royce to discuss future plans. In a report from France reference is made to "unfounded reports" concerning the load distribution in the Caravelle. It is officially stated that the rear position of the power units "eliminates the influence of the power output on the stability of the aircraft." The statement goes on: "The 14 per cent margin in load distribution permits shifting the normal 7 metric-ton payload by 10ft. Whatever the c.g. position, the control characteristics are not affected. The changes in c.g. position, resulting from consumption of fuel, remain below 3 per cent."

S.N.C.A.S.E. Aquilon. Aircraft of this type (which is a French development of the de Havilland Sea Venom) recently carried out their first night-flying operations from Istres. They belong to squadrons 11F and 16F and are some of 40 machines of the type delivered to date. Now in production are the Mks 20, 202 and 203. Improvements incorporated by S.N.C.A.S.E. include ejector seats, sliding canopies, and provision for the machine to operate as a single-seater or two-seater.

S.N.C.A.S.O. Dogue. Thus named is an aircraft projected some two years ago as a light twin-engined machine, for low-level night attack and close tactical support in overseas operations. It is designed to operate from makeshift strips.

S.N.C.A.S.O. Vautour (Avons). A Vautour all-weather fighter has been fitted with two Avon RA.41 turbojets of 9,260 lb thrust and is now beginning its trials. Production Vautours for the French Air Force will have S.N.E.C.M.A. Atars, but one machine has been fitted experimentally with Armstrong Siddeley Sapphires.

Hurel-Dubois H.D.34. In August this year an order was placed for the construction of four H.D.34 aircraft for the French National Geographical Institute (I.G.N.). The original requirements, which were admirably met by the basic H.D.32 design, were for three types of mission: (1) 7 hr to be flown at 9,800ft at 124 m.p.h., with 5,730 lb of photographic equipment; (2) 8 hr to be flown at 16,400ft at 173 m.p.h., with 5,730 lb of equipment; (3) 8 hr to be flown at 23,000ft at 155 m.p.h., with 1,875 lb of equipment. Superficially the H.D.34 will be distinguishable from the "32" by its slightly longer, fully transparent nose, a re-arrangement of the cockpit, and a retractable nosewheel. Fuel capacity will be increased to 1,320 gallons, whereas the tankage of the H.D.32 is 780 gallons. There will be two vertical cameras, with 32 spare reels, and two oblique cameras.



FAIREY F.D.2
(Rolls-Royce Avon)

Span	...	...	26ft 10in
Length	...	...	51ft 7½in

BOUND FOR THE RIO GRANDE

THE very handsome Avro Shackleton M.R.2 long-range maritime-reconnaissance aircraft in the picture above belong to No. 228 Squadron of R.A.F. Coastal Command. Though standard in the matter of equipment and in having the new battleship-grey colour scheme, to which reference is made on page 683, they have been specially decorated with red spinners, the squadron number and the Union Jack. The added finery is explained by Operation Suntan, the training and goodwill tour of Brazil, Venezuela and Colombia, which the four machines began on October 20th. Force commander is Air Vice-Marshal G. W. Tuttle, C.B., O.B.E., D.F.C., Air Officer Commanding No. 19 Group, Coastal Command, who is portrayed at lower right. Officer commanding No. 228 is W/C. K. M. Murray, D.F.C., seen, second from right, in the group below. The setting is the tea bar in 228's aircrew rest room, and on the wing commander's left is S/L. H. Devey, one of his navigators. Facing him, left to right, are S/L. P. H. Hudgell, another navigator, Mr. L. Chorlton, Avro technical service representative, and S/L. I. M. Harper, a pilot.

FIRE-FIGHTING FROM THE AIR

Fixed-wing Aircraft and Helicopters Employed in Long-term U.S. Tests

AIRCRAFT were used extensively in a series of experiments recently completed near San Diego, California, to test several new fire-fighting techniques and to study the behaviour characteristics of large-scale fires.

Called Operation Firestop, the tests had been carried out over a period of one year and were a joint project of several organizations including the U.S. Forest Service and the Los Angeles Fire Departments. Aircraft taking part included Bell and Hiller helicopters, loaned by their manufacturers, two Sikorsky HRS (S-55s) provided by the U.S. Marine Corps, and a modified TBM Avenger from the Paul Mantz Air Corporation of Hollywood. Several other miscellaneous reconnaissance and photographic aircraft were also used.

The tests which involved these aircraft were of two main types. Bulk water drops were made by the TBM, and the value of the helicopters was assessed in providing close air support for the ground fire-fighting teams.

The possibility of using aircraft to drop water on to fires was considered by the Forest Service as early as 1920, and some experiments had been carried out prior to "Firestop." In 1936, the U.S. Forest Service inaugurated extensive water-bombing trials, and in 1946 and 1947 further experiments were made by the service in co-operation with the U.S. Army Air Corps. In these more recent tests the possible adaptation of surplus military aircraft and the use of the proximity fuse for bursting liquid containers at the desired height above fires were studied. It was found that glide-bombing by such types as the P-47 was effective in some cases, but that high-level bombing from B-29s was not sufficiently accurate for use against small fires.

Results of these and other experiments in North America and Australia indicated that there is little hope of completely extinguishing fires from the air, but that it is possible to curtail their spread, and to cool "hot spots." A serious drawback to the use of liquid containers is the danger they present to people on the ground. This prohibits their use in close support for ground teams, or when the fire is in a populated area. Consequently, in "Operation Firestop" it was decided to test the possibility of keeping small fires in check by dropping water, or chemicals, in free fall—that is, without containers. Ground tests determined the minimum quantity of water or chemicals required to hold down small fires before experiments were conducted to develop an aerial delivery system.

The TBM had a disposable load capacity of 5,000 lb. It was sufficiently manœuvrable for the purposes of the tests, cruised at 200 m.p.h. and could slow down to 100 m.p.h. to discharge its cargo. Its bomb-bay was converted into a water-tank by replacing the original doors with plywood doors, and lining the bay with a plywood container divided into two compartments. These held a total of 600 gal. To eliminate the cost of making the unit waterproof, a weather balloon was used to provide a thin rubber lining in each compartment. Toggle switches in the cockpit controlled four bomb-rack shackles on each door of the bomb-bay. When the doors opened, the rubber linings burst, thus releasing the water.

Five test drops were made with this aircraft at heights ranging from ten to one hundred feet. Dropping from 10ft produced a heavy drench 55ft wide and 260ft long. The drop from 100ft produced a drenched strip about 150ft wide, but at this elevation wind drift effected the dispersal pattern.

The final test was made by dropping 570 gal of water just ahead of a small bush fire. The drop was made from a height of 65ft with the TBM travelling at 120 m.p.h. Although the drop was a partial miss, the blaze was cooled by the "fog" and the bush ahead of the fire was damped down.

From this series of tests it was concluded that it is possible to exercise a retardent action on small fires by dropping water, or a non-corrosive fire-retardent chemical, directly on to, or immediately adjacent to, the fire. Although it is not possible to defeat conflagrations by this method alone, these aerial drops could form a valuable aid to ground fire-fighting forces particularly in areas where the radiation level of the fire is too high for human occupation.

One of the HRS (S-55) Sikorskys, loaned by the U.S. Marine Corps for the tests, picks up a "helitanker" unit.

The second series of tests were based upon the use of helicopters for a variety of fire-control purposes and as close support for ground fire-fighting forces.

Studies were made of several types of airborne water containers which could be delivered quickly to the scene of a fire by helicopters. The units were given the name "helitankers," because they combined the advantages of the tank, hose and pump of a small ground tanker with the mobility and speed of a helicopter. One of these units was constructed of two 50-gal metal drums, with a 7½ gal/min pump mounted between them and three hundred feet of lightweight rubber-lined plastic hose attached. This unit was packed in the wire basket that is the standard accessory to all U.S. Marine helicopters. The entire unit, plus water, weighed less than 1200 lb. It was transported by a Sikorsky HRS.

It was stated that for Civil Defence purposes these "helitanker" units may well become stockpile items, ready for any emergency, to be delivered to any area where rubble or roadblocks prevent ground transport. Their use is also envisaged in the crucial initial stages of forest fires.

In another type of test, 400ft of hose were laid in fifteen seconds by a Hiller helicopter.

In the final reports of "Operation Firestop" it is emphasized that the tests were conducted only to determine the feasibility of the methods. Further development and research are needed before they can be put into general use.

AUSTRALIA AND MISSILES

RESEARCH at Woomera on long-range weapons could be the means of preventing a third world war, according to Australia's Minister of Supply, Mr. Howard Beale. The Minister said that there was now a regular shuttle service between Britain and Australia of scientists, equipment and data. Until now research and tests at Woomera had been on short-range guided missiles, which Britain needed for her defence. "In future wars—I mean a third world war," the Minister went on—"the role of fighter aircraft against bombers will be diminished. The guided missile, homing on its target, offers the best form of defence. Later, the Woomera range will be used for the development and testing of offensive weapons which can span tremendous distances."

This year Australia's estimated expenditure on the guided missiles project was £7 million, and to date a total of about £45 million had been spent. Up to 20,000 people in England were doing nothing else but development and research work on weapons the prototypes of which would be tested in Australia.

Australia, Mr. Beale disclosed, had agreed to Britain's carrying out the next atomic tests at Maralinga (South Australia), which had been chosen because of more suitable terrain and conditions than Emu Field, where the second series of atomic tests were held.

COLOURS OF THE DAY

FOR more than 40 years all aeroplanes of the British Fighting Services have been painted according to officially prescribed schemes, intended to facilitate recognition and, on occasion, to denote their function. From time to time, the general development of air operations has dictated changes; there have, for example been three completely different schemes applied to Canberras of Bomber Command. The photographs on this page and the following three pages do, however, illustrate some of the more important types of standard Service colouring at present in use.

Not all can be described as camouflage; in fact some are specifically intended to have the reverse effect. All are, of course, modified by the geometry of the aircraft, so that the boundary between the upper and lower surface colours shall meet the wings or tailplane in the correct manner. It will be noted that this boundary is either low on the fuselage, at the mid-point or at one-quarter of the maximum depth from the top. Further modification is necessary in order to leave such surfaces as radomes unpainted—or finished in a special manner, usually with a white or black surface—and to allow for non-reflecting black areas ahead of the windscreen or engine nacelles, where the sun shining on the basic colour might dazzle the crew.

The red-white-blue roundel is applied in any of three sizes (of 18, 36 or 54in overall diameter) above the wings (where it must not encroach upon a control surface) and on each side of the rear fuselage—except in the case of such aircraft as the Vulcan, where the only convenient side-area is ahead of the wing. On certain types of aircraft the roundel is also applied below the wing.

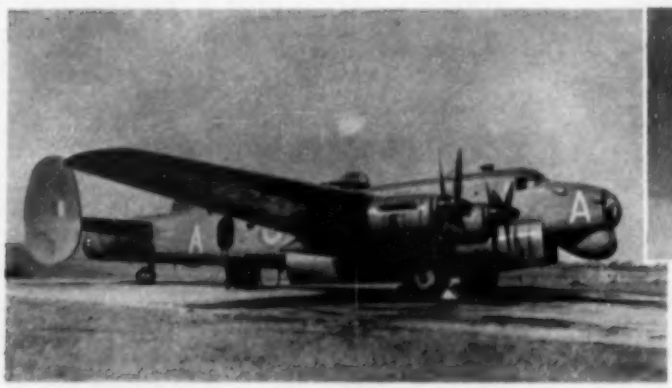
Individual notes are given in the captions to the photographs, pointing out features peculiar to particular types. One factor which cannot be allowed for is the highly erosive effect of intensive high-speed operations through rain or hail, which can strip an airframe down to the metal. Synthetic turbine-oil also has a very adverse effect, which can be seen to the rear of the oil vents of Sapphire-powered Hunters.

In some cases, the aircraft bear individual unit markings. Such insignia are permitted on either a squadron, wing, or "establishment" basis, but individual pilot's insignia are today unusual. Unit markings conform to no set pattern, and may appear on the front or rear fuselage or on the fin.

Day Fighters (United Kingdom): Upper surfaces, dark green and dark sea grey; under surfaces, silver. The photograph shows Hawker Hunter F.1s (nearest the camera is the last F.1 built at Blackpool) of No. 43 "Fighting Cocks" Squadron, who use black-and-white squadron dicing. This unit is at present touring Scandinavia.

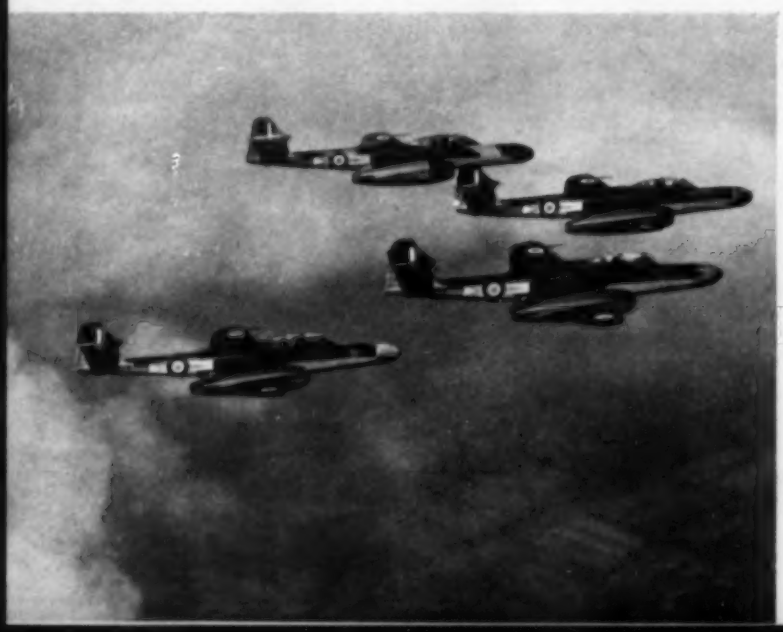
Tactical Air Forces: Upper surfaces, dark green and dark sea grey; under surfaces, P.R.U. blue. The photograph shows a de Havilland Venom F.B.4, serial number WR 413, of the 2nd Allied Tactical Air Force, operating from a NATO base in north-west Germany.

Bomber Command: Overall high-speed silver finish. The aircraft shown—one of the second production batch of Vickers-Armstrongs Valiant B.1s—has numerous unpainted dielectric surfaces. Bombers have 24in serial numbers—three times the usual size. Roundels are not painted under the wings. Photo-reconnaissance aircraft are similar, but have an 8in serial number. The few remaining piston-engined bombers are finished in medium sea grey above and "anti-searchlight glossy black" on the sides, vertical tail and under surfaces. Some Canberras are also painted to this scheme, and other Canberras have an interim finish, with the upper surfaces light slate grey and medium sea grey and the sides and under surfaces P.R.U. blue. Both these earlier schemes use white serial numbers.



Coastal Command: Glossy medium sea grey overall. This is an interim scheme, and, in an emergency, aircraft would revert to the grey/white finish (with grey serial number) typified by the Seamew (inset). The photograph shows an Avro Shackleton M.R.1 of No. 120 Squadron. Spinners are painted black, and serial number and other lettering is in white. There is no roundel under the wings.

All-weather and Night Fighters: Upper surfaces, dark green and dark sea grey; under surfaces (from the horizontal centre-line), medium sea grey. The photograph shows three Armstrong Whitworth Meteor N.F.14s of No. 46 Squadron, together with a Meteor N.F.12 (port wing-man) painted according to an earlier scheme using medium sea grey on both under and upper surfaces.



Intruders: Night-attack machines are finished in dark green and dark sea grey to the horizontal centre-line, below which they are matt black. The machine shown is WT 328, an early English Electric Canberra B.8. Roundels are not painted under the wings and the serial number (24in high on the fuselage) is in white.

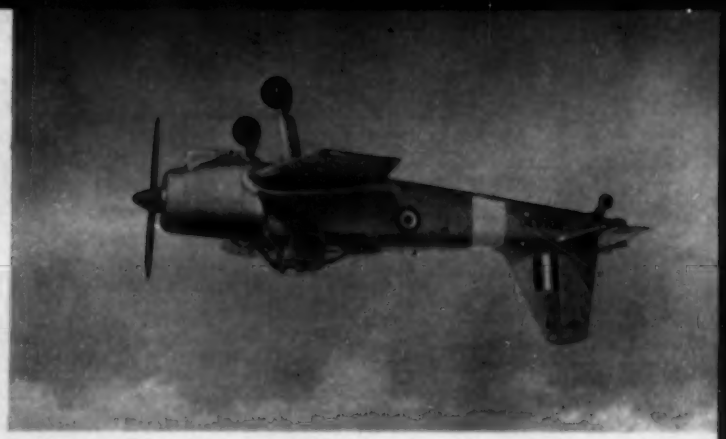
Transports: In peace-time, Service transports are finished in light-weight silver, with the fuselage top painted with white heat-reflecting enamel. These Handley Page Hastings C.3s are from a Lyneham Squadron, with a black chest line.

Rescue: Yellow overall finish, for sea/air search and rescue aircraft. The example shown is XJ 434, a recently built Westland Whirlwind HAR.2, of No. 22 Squadron Royal Air Force (Coastal Command), based at Thorney Island.

COLOURS OF THE DAY . . .

Royal Navy: Operational aircraft of the Fleet Air Arm are painted as follows: upper surfaces, extra-dark sea grey; under surfaces and vertical tail surfaces, sky (a duck-egg green). No fin flash is used and the serial number is only 4in high. The words ROYAL NAVY are painted as large as possible immediately behind the fuselage roundel (see D.H.110, inset), but on some aircraft this is impracticable owing to lack of space. An example is the Hawker Sea Hawk (Sea Hawk FGA.4s of No. 898 Squadron are shown), and here the words are written above the serial number in 4in letters. Other features are the squadron badge, always on the front fuselage, and the large number (such as 139, on the machine in the foreground) in which the first figure generally denotes the number in the crew. In the background are early-warning Skyraiders, still painted in U.S. Navy midnight blue. These aircraft have a crew of three, and one machine in the photograph accordingly bears the identification number 317, in white. Non-operational Naval aircraft conform to the standards laid down for R.A.F. aircraft of similar function.

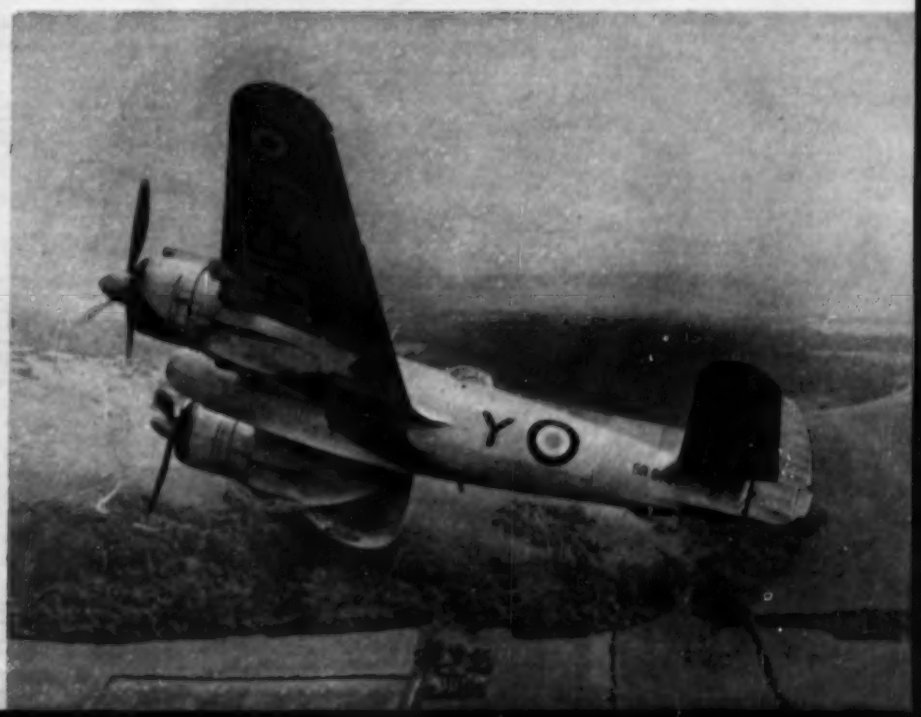
Army: Air Observation Post, liaison and other Army aircraft are finished in a camouflage of dark green and dark earth (the latter is a medium brown tint) on all surfaces. Numbers and lettering appear in white. Example: Auster A.O.P.9.



Training Command: Light-weight silver finish, with broad yellow bands around the wings and rear fuselage. These bands are either 2ft, 3ft or 4ft wide, according to the size of the aircraft; on the Hunting Percival Provost T.1 they are 2ft wide.

Pilotless Targets: Upper surfaces, to one-quarter of the fuselage depth cream; under surfaces and vertical tail surfaces red. Example: Fairey Firefly Mk 8.

Meteorological: Operated by Coastal Command, these aircraft are painted in medium sea grey, with white under surfaces. This Handley Page Hastings Met. 1 (TG 616) belongs to No. 202 Squadron, based at Aldergrove, County Antrim.



Tugs and Droppers: Target-towing machines and aircraft used for parachute test-dropping are finished in light-weight silver above, with yellow under surfaces on which are superimposed black bands 3ft wide inclined at 30 deg to the line of flight, the centres of the bands being 9ft apart. A yellow band is also applied to the fuselage. Example: Bristol Beaufighter TF.10, photographed a few weeks ago over Somerset.

No. 825 Squadron Comes of Age

From Fairey IIIFs to Gannets

THE Fleet Air Arm's first Swordfish squadron celebrated its 21st birthday on October 8th. Now equipped with Fairey Gannets and based at R.N.A.S. Culdrose, the Squadron began its day of celebration with a fly-past. Four Gannets took off in a remarkably tight box and gave a demonstration of the aircrafts' handling and operational characteristics, witnessed by guests who included Vice-Admiral Caspar John, C.B., Flag Officer Air (Home), Capt. J. Robertson, who commanded No. 825 when it first received Swordfish twenty years ago, G/C. Gordon Slade, chief test pilot of the Fairey Aviation Co., and Mr. Peter Twiss, Fairey test pilot responsible for the flight testing of the F.D.2.

In the afternoon a Rugby match between the Squadron and Station was decided nine points to nil against the Squadron—a set-back soon forgotten during the evening's cocktail party and dance.

Looking back, it may be recalled that probably the most famous feat of arms in No. 825's singularly notable career was the attack on the *Scharnhorst* and *Gneisenau*. On February 12th, 1942, six Fairey Swordfish escorted by only ten fighters took off from Manston as Britain's last hope of stopping these two German warships from getting through the English Channel. Hoards of enemy fighters soon engaged the fighter escort; but, with his own aircraft extensively damaged, Lt-Cdr. E. Esmonde led his formation at wave-top level through the flak of the enemy screen and on towards the battle-cruisers. All six Swordfish were shot down before reaching their target and only five of the eighteen aircrew were saved, three of them badly wounded. Esmonde was posthumously awarded the Victoria Cross, and all the surviving aircrew were decorated.

The squadron was born in the summer of 1933 aboard H.M.S. *Eagle*, then serving on the China station, when Nos. 440 and 460 Flights, equipped with Fairey IIIFs, were combined to form No. 824 Squadron.

The squadron was re-numbered 825 on October 8th, 1934, and served with the Mediterranean Fleet in *Eagle*, and later in *Glorious*, for the next four years. An important date during this time was July 1936, when the Squadron became the first to be equipped with the Fairey Swordfish. The outbreak of war saw No. 825 aboard H.M.S. *Glorious*, protecting merchant shipping in the Indian Ocean. The squadron was recalled from Ceylon in April 1940, at the start of the Norwegian campaign and disembarked just a week before *Glorious* was sunk.

After a period of miscellaneous operations from Detling, Kent, against submarines and E-boats and against enemy batteries, tanks and transport in the Calais area, the squadron was withdrawn and re-formed under the command of Lt-Cdr. Esmonde. They embarked in *Furious* for Norway and, after distinguishing themselves in action there, rested for a short time at Lee-on-Solent.

In May 1941 they sailed for the Atlantic in H.M.S. *Victorious* to search for *Bismarck*. The successful strike by a torpedo which hit the boiler room was instrumental in the final destruction of the enemy giant.

Then No. 825 transferred to the former *Ark Royal*. A subflight went to Malta to relieve the hard-pressed Malta garrison, the main body of the squadron protecting the Malta convoys and dive-bombing targets in Italy, Sardinia and Pantellaria. When *Ark Royal* was sunk in November 1941 some of the squadron aircraft managed to fly off to Gibraltar; every man in the squadron was saved.

New "Stringbags," but practically the same men, comprised the squadron after its re-formation at Lee-on-Solent early in 1942. Then came the *Scharnhorst* and *Gneisenau* epic.

In September 1942 three aircraft embarked in H.M.S. *Avenger* to provide the first close-carrier escort for a North Russian Convoy. Sixteen U-boats were sighted and attacked.

From December 1942 to March 1943 No. 825 was under Coastal Command, operating in the English Channel. Then, in March, it embarked in *Furious* for operations from Scapa and Iceland and after a period ashore (with six Hawker Hurricanes added to the complement) sailed in H.M.S. *Vindex* for anti-submarine patrols in the Atlantic. A spell in Northern Ireland with Coastal Command and two more operations (from *Vindex* and *Campania*) supporting the Russian convoys, and No. 825 flew ashore to disband at Machrihanish in April 1945.

Fairey Barracudas equipped No. 825 on its re-formation three months later and when H.M.C.S. *Warrior* was commissioned in the Royal Canadian Navy in 1946 No. 825 became a Firefly-equipped R.C.N. squadron. A year in Canada and a cruise to Bermuda in *Warrior* and No. 825 returned to England to re-equip with Firefly 4s.

In April 1948 the squadron joined the new carrier H.M.C.S. *Magnificent* and, after a further period in Canada came back to the United Kingdom for the newest type of Firefly, the Mk 5. The squadron's third trip to Canada saw the end of No. 825 as a R.C.N. squadron. It was re-equipped with Grumman Avengers and re-numbered No. 880, the number 825 reverting to the Royal Navy.

The new No. 825 Squadron served for a time with *Theseus* in Malta after re-forming on June 12th, 1951, before sailing for Korea in H.M.S. *Ocean*. May 1952 saw the squadron on operational service, dive-bombing and rocket attacks (with Firefly 5s) being made against the usual miscellany of ground targets. In recognition of its distinguished service in Korea No. 825 was awarded the Boyd Trophy for 1952, sharing it with No. 802 Sqn.

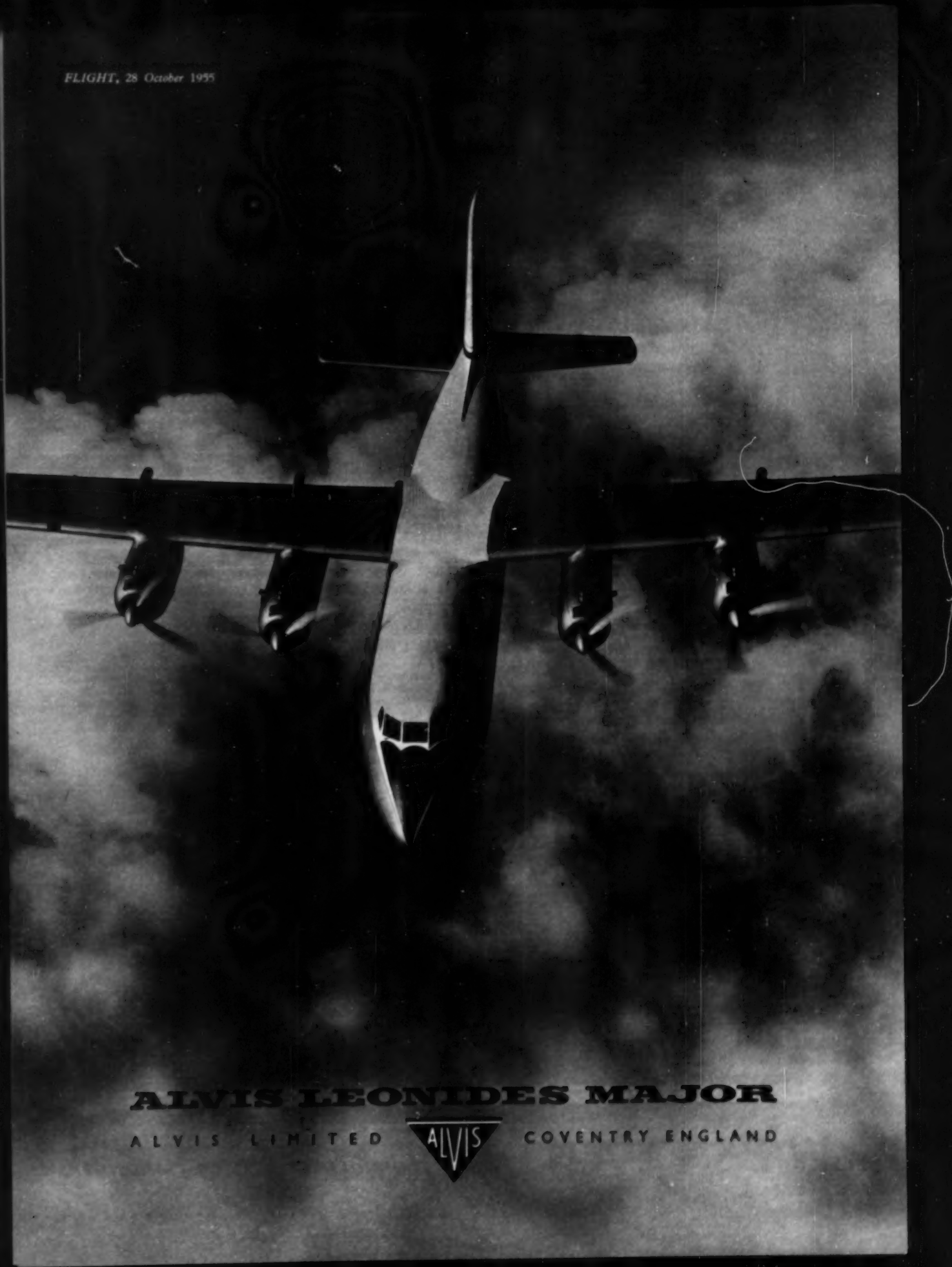
Back in England (under the command of Lt-Cdr. R. P. Keogh) the unit succeeded, during working-up trials with eight Firefly 5s, in dis-masting the target ship in Bracklesham Bay with rockets —for long the cherished aim of many a Fleet Air Arm squadron.

After taking part in its second Coronation Review Fly-past (it also took part in the 1937 Review) No. 825 embarked in *Eagle* for the usual round of exercises, and then February 1954 saw the re-union of two old friends when No. 825 flew aboard H.M.S. *Warrior* again. They sailed for the Far East and repeated their ground attack operations of 1952, this time against bandits in Malaya. In October 1954 *Warrior* and the squadron left the Far East to show the flag in South Africa.

Off Mauritius, both Nos. 825 and 811 Squadrons put up a magnificent fly-past, the Fireflies in an anchor formation and the Sea Furies forming the letter "W." (Since the squadron had only nine pilots it "borrowed" one L.S.O. and one commander (Air) to make up numbers!)

The squadron returned to Lee-on-Solent and disbanded on December 30th, 1954. No. 825 was re-formed with eight Fairey Gannets under Lt-Cdr. J. R. C. Johnston on July 4th, 1955, at R.N.A.S. Culdrose.

At R.N.A.S. Culdrose, Cornwall, where No. 825 Squadron recently came of age, as recorded on this page, are seen Gannets of Nos. 816 and 817 Squadrons, Royal Australian Navy.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MAJOR POWER — MANY RÔLES

The Westland Whirlwind Helicopter is now available with the Alvis Leonides Major engine as an alternative to the standard Pratt and Whitney Wasp. This powerful British engine gives the Whirlwind enhanced load lifting and hovering ability and increases the height attainable in forward flight. These additional attributes of a Helicopter that has already been proved during world-wide civil and military service are particular considerations where operation is required in countries where high atmospheric temperatures, humidity and altitude are determinate factors.

The Westland Widgeon is the latest general-purpose, medium-size Helicopter to be built in Britain. It is a development of the famous and versatile Dragonfly and incorporates many of the well-tried and highly successful engineering features which have been responsible for the outstanding success of Westland Helicopters. With accommodation for four passengers and pilot—or two stretcher cases, medical attendant and pilot—it offers great possibilities for many civil and military rôles.

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THE AERONAUTICAL BOOKSHELF

"The Greatest Airlift—the Story of Combat Cargo," by Captain A. G. Thompson, U.S.A.F. Obtainable from H.Q. 315th Air Division (Combat Cargo), A.P.O. 704, San Francisco, California, U.S.A. Illustrated. Price $3, plus $1.02 postage and insurance.

COMPARED with our own R.A.F. Transport Command, America's military air transport and communications organization seems a confused and incompatible jig-saw, with M.A.T.S., the Fleet Logistics Air Wing, U.S.A.F., Army and Marine air units all indulging in a general free-for-all. In fact, although there is some overlapping and inter-Service rivalry, each Service has its own particular duty to perform. M.A.T.S., for example, is responsible for carrying military personnel, equipment and supplies to overseas bases. From there it is the job of units like Combat Cargo Command to deliver the troops and material to combat areas, either by landing at advanced bases or by airdrop.

This book tells in great detail of the achievements of the U.S.A.F.'s 315th Air Division (Combat Cargo) during the Korean War, and is illustrated with hundreds of first-class photographs. A copy should be given to all those responsible for planning our British defence forces; because it leaves no doubt of the value, and even the vital necessity of adequate air transport services in modern warfare.

The story starts in a small way; because, when the North Koreans crossed the 38th Parallel in June 1950, the 374th Troop Carrier Wing at Tachikawa, Japan, was the only U.S. air transport unit in the Far East. For three months, its C-54s carried on the airlift alone, delivering bombs, ammunition, petrol, rations, medical supplies, weapons and every other kind of high priority cargo to front-line units in Korea.

In August 1950, Lt. Gen. William H. Tunner, commander of the Berlin Air Lift, was sent to Japan to organize a major airlift to Korea. Three squadrons of C-119 Flying Boxcars of the 314th Troop Carrier Group arrived at Tachikawa and, with the 374th T.C.W. and the C-46s of the 1st Provisional Group, formed the nucleus of Combat Cargo Command. Jeeps, trucks and steam-rollers were now added to the freight list, with hundreds of wounded making up return loads in the C-46s.

As the scale of the fighting grew, so did Combat Cargo Command, and so did the variety of jobs it was called on to undertake. As early as October 20, 1950, its C-119s and C-47s were able to drop 3,000 paratroops and 300 tons of weapons, carriers, jeeps, field artillery, anti-tank guns and heavy pallets of supplies to harry the enemy north of Pyongyang—an operation that was watched personally by General MacArthur from his aircraft, the *Bataan*. Later operations involved dropping another 77,000 troops and more than 18,000 tons of supplies, including the steel bridge which allowed the trapped 1st Marine Division to escape from the Chosen reservoir area to Hamhung in November 1950.

Such work involved great hazard, especially after the Chinese entered the war, and there is plenty of excitement and drama in *The Greatest Airlift*, as well as sufficient facts and figures to satisfy the most avid statistician and historian.

"Technical Publications," by C. Baker, A.R.Ae.S. Chapman and Hall, Ltd., 37 Essex Street, London, W.C.2. Illustrated. Price 36s.

"WORDS and diagrams should never be an encumbrance: they should be tools as adaptable and vital to the technician as a centre lathe is in the hands of a skilled turner. If words are tiresome and diagrams unconvincing, they have been ill chosen, they are unsuitable tools for the job and should be replaced by a better set. The bricklayer cannot lay his bricks with the aid of a shovel, it is unsuitable for the job. It would put down too much mortar, just as the voluble mind puts down too many words and spoils the building of its edifice by a mass of verbosity.

"Documents cannot be dispensed with, their numbers may not even be reduced, but the quality of many of them can be substantially improved: more expressive words can be chosen and diagrams inserted which have been properly designed and not allowed to evolve themselves in a slovenly and haphazard manner. The pen, it is said, is mightier than the sword. Let the pen that writes and illustrates excel the tempered blade of the finest product it describes."

These words, taken from Mr. Baker's introduction, are themselves the strongest justification of the writing of the book. How true they are! And how true, it is too, that many a man well qualified by his technical achievements to impart knowledge to others is handicapped by an inability to express his ideas clearly on paper.

The ability to write technical literature in impeccable English is a gift possessed by very few; but there are rules and conventions which, if learned and remembered, will enable a writer at least to express himself concisely and precisely, in such a way that the reader is left in no doubt as to his meaning.

This altogether admirable textbook explains these guiding principles, offering "before" and "after" examples that drive each point forcibly home. It also offers a great deal more—in fact, it covers the whole field of the preparation of technical literature, the techniques of illustration by drawings and photographs being as thoroughly explained as are the verbal processes.

Though concerned with engineering in general, *Technical Publications* has a distinct bias towards the aeronautical industry (there are clues as to where, presumably, its author practises what he preaches). We strongly commend Mr. Baker's book to all in the industry whose primary job it is to convey ideas to others in words and pictures. The beginner will find it a patient and friendly teacher; the expert will discover it to be a useful memory-jogger on details both likely and unlikely.

"Celestial Navigation for Yachtsmen" (third edition), by Mary Blewitt, Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Illustrated. Price 6s.

A REVISED edition of a helpful guide, this book is intended particularly for the beginner in navigation. The system used for working out a sight is based on R.A.F. practice and requires the use of two Air Ministry publications, the *Air Almanac* and A.P. 3270 (*Sight Reduction Tables for Air Navigation*). The book contains many practical worked examples, is of a handy size (7¼in by 4¼in) and has a waterproof binding.

"Miniature and Precision Cameras," by J. Lipinski, B.Sc., D.I.C. Published for "Amateur Photographer" by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Illustrated. Price 30s.

THIS new book for amateur photographers has been written for the many advanced-photography enthusiasts who seek to widen their scope by a better understanding of their instruments. Well illustrated with good-quality diagrams and photographs, this book provides a detailed study of the modern precision camera with a chapter devoted to representative well-known types.

OTHER BOOKS RECEIVED

The Third Service, by Air Chief Marshal Sir Philip Joubert. Thames and Hudson, Ltd., 244 High Holborn, London, W.C.1. Price 21s.

The Mindworm, by C. M. Kornbluth. Michael Joseph, Ltd., 26 Bloomsbury Street, London, W.C.1. Price 12s 6d.

Against the Sun, by Edward Lanchbery. Cassell and Co., Ltd., 37-38 St. Andrew's Hill, London, E.C.4. Price 16s.

The Direction of War, by A.V-M. E. J. Kingston-McCloughry, C.B., C.B.E., D.S.O., D.F.C., R.A.F. Jonathan Cape, 30 Bedford Square, London, W.C.1. Price 16s.

Aircraft Engines of the World, by Paul H. Wilkinson. Sir Isaac Pitman and Sons, Ltd., 39 Parker Street, London, W.C.2. Price 50s.

Studies for Student Pilots, by Michael Royce. Sir Isaac Pitman and Sons, Ltd., 39 Parker Street, London, W.C.2. Price 25s.

Aerodynamics, by N. A. V. Piercy, M.I.C.E., M.I.Mech.E., F.R.Ae.S. 1955 reprint of the 1947 edition. English Universities Press, Warwick Square, London, E.C.4. Price 30s.

Playground in the Sky, by "Bill" Gotch. Hutchinson and Co., Hutchinson House, Stratford Place, London, W.1. Price 12s 6d.

The Soaring Pilot, by Ann and Lorne Welch and F. G. Irving. John Murray, 50 Albemarle Street, London, W.1. Price 15s.

The Law of Sea and Air Traffic, by Derek H. Hene, M.A. (Cantab.). Shaw and Sons, Ltd., 7-9 Fetter Lane, London, E.C.4. Price 50s.

Jump For It!, by Gerald Bowman. Evans Brothers, Ltd., Montague House, Russell Square, London, W.C.1. Price 12s 6d.

An Introduction to Electronic Analogue Computers, by C. A. A. Wass, B.Sc., A.M.I.E.E., A.Inst.P. Pergamon Press, Ltd., 4-5 Fitzroy Square, London, S.W.1. Price 40s.

Morale in War and Work, by T. T. Paterson. Max Parrish and Co., Ltd., 55, Queen Anne Street, London, W.1. Price 18s.

Second Thoughts on Radio Theory, by "Cathode Ray" of *Wireless World*. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 25s.

Diesel Maintenance, by T. H. Parkinson, M.I.Mech.E., edited by Donald H. Smith. Fourth edition. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 12s. 6d.

JET-FLAP DEVELOPMENT

Mr. I. M. Davidson's Lecture before the Royal Aeronautical Society Part II

ON October 20th, Mr. I. M. Davidson, B.Sc., A.F.R.Ae.S., of the National Gas Turbine Establishment, read before the Royal Aeronautical Society a paper on "Jet-flap Development." Last week we gave a slightly abridged summary of the first part of the paper, and in these pages the second half is given at almost full length, together with the majority of the illustrations—which, incidentally, are Crown copyright. The jet-flap principle, first demonstrated by the Ministry of Supply at the S.B.A.C. Show last month, was explained in an article in "Flight" of September 30th.

INTRODUCING the second part of his paper, Mr. Davidson said that before the jet-flap principle could be applied properly much of the theory and practice of low-speed flight must be written anew for, aerodynamically speaking, the situation was akin to that which prevailed in or about the year 1900. With technology as it now stood this might not, of course, take long; but for the present it would be foolish to attempt any prediction concerning the aircraft types which would emerge.

Nevertheless, it remained to be shown that a practicable aircraft could be constructed around the principle.

The lecturer now continued: "The analogous flap-size for a typical aircraft of, say, Comet calibre is illustrated in Fig. 21, which suggests that in cruising flight the machine could be regarded simply as a conventional aeroplane. In low-speed flight the situation is not so obvious for, although there is now a rough working knowledge of the properties of a jet-flapped wing, little has been deduced about the likely behaviour of a whole aircraft. One thing, however, is certain—that in flight through still air the maximum C_L value will be determined solely by the available thrust and that it will be very large indeed.

"For example, in landing trim this machine might display a wing loading of 55 lb/sq ft and, with fully developed by-pass engines, a jet reaction to aircraft weight ratio of about 0.55. With no contingency allowance and with a jet angle of some 40 deg even this quasi-conventional aircraft would be off the present experimental map, but a slight extrapolation suggests for it an approach speed of 35 kt at a total lift coefficient of about 13½. The low-speed problem is thus mainly that of so designing the machine that, with all due allowances for engine failure, gusts, baulking and human error, and so on, the ideal, still-air performance can be approached as closely as possible. That is, of course, the common problem of all high-lift aircraft, but with the jet flap there exist two novel and potentially powerful possibilities.

"(*i*) There is in principle a chance of making the aircraft unstallable.

"(*ii*) Due to the inherent lift-thrust coupling, it should be possible to control far below the minimum-drag speed.

"However, in striving for these characteristics it is found that not only the lift but also all its controlling increments must be generated aft of the effective mid-chord point, and this suggests that the conventional elevator system be abandoned. So far as the pilot is concerned there could be a perfectly conventional cockpit layout and the rudder would follow normal practice, but the tailplane would be fixed, while the jet flap would assume the functions of the elevators, ailerons, flaps and air brakes.

"In practice the flap control might lower the jet through some 30 to 40 deg, while at the same time trimming the one-piece tailplane to an appropriate downwash angle. On top of this, the control column would provide at all times a vernier action of plus and minus a few degrees, the jets on either side of the fuselage acting together as elevators and differentially as ailerons. Finally the jet would be divided into a number of continuous spanwise sections, adjacent elements moving differentially about any common datum for the purpose of generating induced drag independently of the overall lift."

Discussing the shrouded jet, the lecturer said that, in practice, with a pure or simple jet flap there were two quite unacceptable snags—the responsibility for the aircraft control system must be handed at once to the engine designer, while the very survival of the craft clearly depended upon the unfailing operation of its powerplant. These difficulties could be overcome by the introduction of a small hinged flap or jet shroud as illustrated in Fig. 22. The term "shroud" arose because the arrangement was originally conceived only for the control of the jet and the reduction of its entrainment drag; but, since then, the appendage had been found to offer so many engineering advantages that its atrophy now seemed unthinkable.

"In operation," continued the lecturer, "the jet follows the shroud by what is commonly termed the Coanda effect and, with a little care, there is no difficulty in turning any sort of jet through 90 deg and more. The best shroud size will vary from one design to another, for it depends upon many diverse factors; but typical values might lie in the range from three to ten per cent of the wing chord, with a bias towards the lower figure.

"Since the lift from a small flap varies as the square root of its chordal extent, the effects of the shroud and jet will clearly not be additive. One approximate theoretical result is displayed in Fig. 23, which suggests, for example, that while the separate C_L values from a five per cent shroud and a jet of C_J value 1.0, may be respectively 1.8 and 5.4, they will yield in combination only 6.1. Thus, while the shroud will be all-important in cruising flight, it can, with perhaps one exception, be neglected in first order high-lift calculations. The exception is its effect on the centre of total lift, and this could be important because it makes possible a reduction of the unusually large tailplane volume coefficient.

"This large tail volume may prove embarrassing, since it implies, of course, extra drag and structure weight. The difficulty arises because, as in Fig. 24, the aircraft centre of gravity will be in the vicinity of its mid-chord point, so that the distance between the aerodynamic centre of the wing and that of the whole aircraft—that is, the neutral point—must have about twice its conventional value.

"In high-speed flight the equivalent of elevator control will be a movement of the shroud, so that the controlling lift increment will be generated close to the mid-chord point and the response will be a ballooning of the aircraft with the tailplane serving purely as a weathercock to pitch it into the resulting climb.

"In low-speed flight with a high aspect-ratio and the tailplane properly trimmed, the balance of forces should be as in Fig. 25. Its centre of lift having moved aft, the wing will exhibit at zero incidence a large nose-down pitching moment about the centre of gravity. This will be balanced partly by the upwash and downwash couple on the fuselage and partly by under-trimming the tailplane, but also by the whole machine adopting automatically a nose-down equilibrium attitude. With sufficient of this third ingredient it is clear that the more lift the pilot applies the farther does the craft move from its stalling incidence—hence the possibility of an unstallable aircraft."

Mr. Davidson went on to remark that, since the jet flapped aerofoil was so insensitive to upper-surface separation effects it might well prove a cure for many of the vices commonly associated with sweepback. Hence, in a first look at the three-dimensional picture, it was safe to omit plan-form in favour of aspect ratio.

"Two-dimensionally," he continued, "it has been suggested that the aircraft should be designed to adopt in low-speed flight a small negative incidence. In practice the argument remains, but the nose-down attitude will be struck relative to the downwardly induced mainstream rather than to the flight path. Hence, while

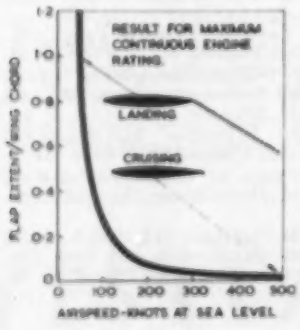
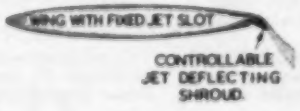
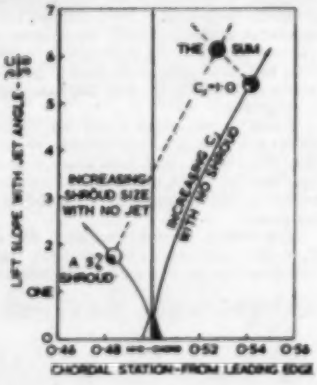


Fig. 21 (left). Analogous flap-size for a typical airliner.

Fig. 22 (below). A practical embodiment.

Fig. 23 (right). Typical theoretical result.





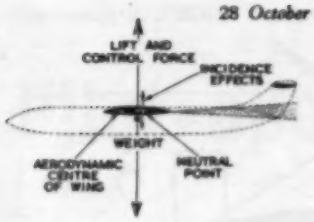


Fig. 24. General arrangement for control without incidence.

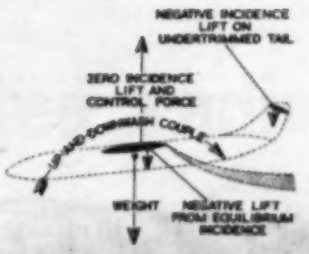

NEGATIVE INCIDENCE LIFT ON UNDERTRIMMED TAIL
ZERO INCIDENCE LIFT AND CONTROL FORCE
WEIGHT
NEGATIVE LIFT FROM EQUILIBRIUM INCIDENCE

Fig. 25. Balance of forces at low speed.

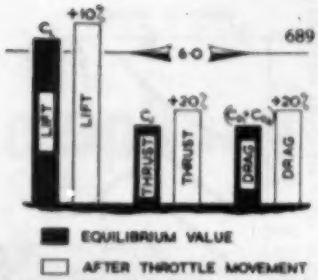


Fig. 26. Throttle control on approach.

the static stability of the machine will be unimpaired, its attitude relative to the flight path will be one of such a positive incidence that, to a first order, the two-dimensional lift and centre of lift will be obtained independently of the aspect ratio.

"In the last analysis, the crucial requirement for good low-speed handling is that, without throttle adjustment, an increase in C_L should produce a sustained increase in the angle of climb. For any machine controlled by elevator movement this condition defines the minimum drag speed, but for a jet-flapped wing controlled through its throttles the handling limit is very much lower; indeed, it is well below the speed at which level flight is possible.

"The reason can be seen in Fig. 26, which depicts the relative lift, jet and drag coefficients for a typical landing approach. Since the machine would land in a fully streamlined condition, its profile and parasitic drags will be so small that, in a first analysis, they can be balanced against the rate of descent and forgotten. Thus, while the thrust will be equal to the sum of the induced and jet drags, these three all increase directly with C_L^2, so that any throttle adjustment will vary the lift without disturbing the thrust-drag balance.

"Hence, in practice the pilot can use his throttles as a rate-of-descent control which produces no first order change in the air speed or attitude of the craft."

Under the sub-heading "Some Factors Affecting the Maximum Lift," the lecturer said that, since the two-dimensional experiments had disclosed significant ground-interference effects, it might reasonably be supposed that, during the take-off and landing, these would cause some embarrassment. No assessment was yet possible, but observation suggested that the effects were of the same order as, but in the opposite sense from, those which normally occurred as a result of suppression of three-dimensional effects; so in the long run the overall disturbance might prove trifling.

Mr. Davidson continued, "While little enough is known about the sort of gusts which will be encountered, virtually no information is available concerning the likely dynamic response of a jet-flapped aircraft. The one established fact is that the lift on a jet-flapped wing varies not as the square of, but directly as, its flight speed. Hence, for given loading conditions, a horizontal gust will have much less effect than it would on a conventional machine.

"Were one wing to drop in a gust, a natural reaction would involve the application of opposite aileron, which produces a differential movement of the jets on either side of the fuselage. Thus, both the induced and jet drags would increase on the dropped wing while decreasing on the other so that, as the machine regained an even keel, it would turn markedly, off course.

"With all engines intact in still air such an incident could not, of course, arise, for any required lateral or directional correction would be made as a slow, fully co-ordinated manœuvre. Thus it is evident that one way in which atmospheric turbulence might limit the maximum lift is through the creation of lateral handling difficulties which are analogous to those that occur with a conventional aircraft well below its minimum drag speed.

"The probable stability effects are at first sight more serious, for, although the pilot cannot stall the aircraft, the encounter during a 40-knot approach of even a moderate up-gust must be presumed to cause trouble. However, the situation is by no means as bad as it looks at first, for, apart from two obvious evasive design measures, the stall may itself transpire to be relatively innocuous.

"The first measure is applicable only to highly powered aircraft of moderate aspect ratio on which the three-dimensionally induced negative incidence might be twenty degrees or more. With plenty of thrust in hand, it could pay to accept, say ten degrees of this to yield on the one hand a reasonable landing attitude and on the other an inherent anti-gust margin. On a high-speed aircraft the aspirated air velocity will be some 700 or 800 ft/sec, and this suggests the second measure for, in low-speed flight, it would correspond to an extremely high suction in the intake plane. Thus the intake system could comprise a continuous, full span, leading-edge slot, such that the stalling incidence of the wing is substantially increased.

"Superficially, this arrangement closely resembles a well known system of leading-edge boundary-layer control, but the likeness is misleading; for one thing, the aspirated flow is vastly greater than that in the boundary layer. This arrangement might, indeed, prove a logical and important move in the aerodynamic synthesis of the aircraft for, since the small intake width could lend itself to the installation of an unusually efficient diffuser, followed by low duct velocities, there need be little or no resulting intake loss penalty.

"However, not all aircraft can have buried engines; the majority are and always will be propeller-driven, and for these the jet-flap principle will be no less important than for their better-integrated brethren. Naturally, there is always the possibility of conventional leading-edge boundary-layer control; but also there is a more economic alternative. When the long upper-surface bubble finally bursts to form an open wake the lift loss must clearly be confined to its induced component, which acts well forward of the aircraft centre of gravity. Thus, even with a two-dimensional aerofoil it is to be expected that the stall will be accompanied by a substantial restoring moment, and such a result is quite evident in the curves of Fig. 27. With a complete aircraft the effect will be even more pronounced, due to the loss of downwash on the rear fuselage and tailplane, so that in practice the stall may well constitute a handling problem rather than a hazard.

"Although the aircraft may thus take care of itself in pitch there remains the difficulty of the dropped wing. At this point major dynamic effects must be presumed to cloud the picture, but there can be little doubt that, in the presence of an ample thrust reserve, safety can be guaranteed at the expense of spoiling the approach. However, to keep things in perspective, it should be remembered that the object of the exercise is not to line up with a runway at, say, 120 knots, but to drop into a cabbage patch at forty or less."

Turning to results of possible engine failure, the lecturer said that, as with gust behaviour, the precise allowances which must be made could not yet be assessed, and would emerge only after much flying experience had been accumulated. However, since this contingency was even more amenable to design treatment, it was well worth looking at a few cardinal principles; the first question was "what happens when the fuel runs out?"

"In modern practice the forced landing is commonly to be dreaded, but with the sort of speeds now under consideration and an all-up weight of 100,000 lb or so, there is clearly every hope of a safe descent even in a mountainous or well-populated terrain. Thus, it would be utterly illogical not to carry in an emergency system the five minutes' fuel which would be required for air-braking and crash landing purposes after a long, unpowered glide from altitude.

"In the more likely event of an engine cut during take-off or landing, there are two main points to be watched. The first is that the most embarrassing consequence will be neither the loss of thrust nor the loss of lift, but rather the yawing and rolling moments which must be checked immediately after the incident. The second is that there is no fundamental difficulty, but only an economic one; for the necessary thrust margin will depend primarily on the number of engines employed and the skill of the designer.

"In returning once more to the example, its wing layout might follow the scheme of Fig. 28. Basically, there are eight identical engines each powering one-eighth of the wing area, and all of these, being by-pass units, would be required for the cruise. Although they are shown as four-cylinder units, this has nothing to do with the problem of engine failure; but is simply for ease in packing.

"Ideally, the exhausts would be pooled entirely or in groups, but for several obvious reasons this temptation must be resisted. Although it is reasonable to insist that the control system shall cope with a failure of any one of the six inboard engines, it cannot be expected to handle a single outboard failure. Hence, the outermost engines would have cross-coupled fuel systems—rather like a Ward-Leonard set—so that whatever happened they would run down together.

"Now this powered wing incorporates two essential aerodynamic ingredients—the jet flap itself and the fully integrated, anti-gust intake. While the former may be allowed to fail the latter cannot, and so part of the wing must be used as a transfer duct which connects each engine through its non-return intake valve to the

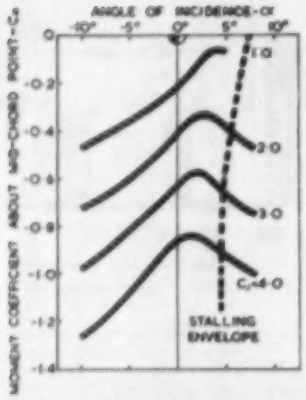


Fig. 27. Stalling stability plot of the 31.4 deg tunnel model.

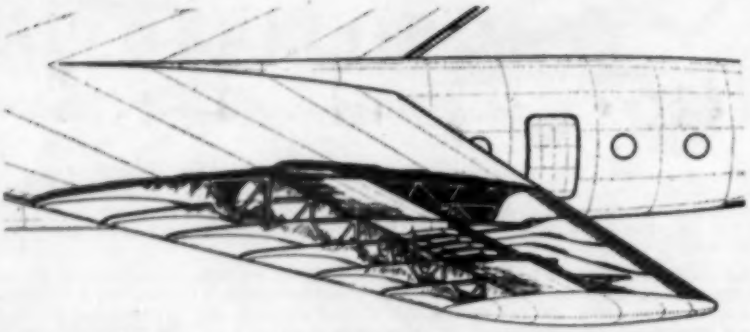


Fig. 28. A hypothetical layout as illustrated by the lecturer. The multiple buried turbojets are aspirated via a thin leading-edge slot and exhaust through flattened fish-tail pipes along the trailing edge.

JET-FLAP DEVELOPMENT . . .

common intake slot. Structurally, very little of this cold, low pressure ducting need be parasitic and, as illustrated, it would transport the air at little over 200 ft/sec.

"To reduce to a minimum the overall disturbance following an engine failure, the shroud must clearly be made to do as much work as possible. For example, when a five per cent shroud is compared at the same angle with a pure jet of C_J value 2.0, it is found to yield fully one-quarter of the lift of the latter. However, in the event of engine failure the unblown shroud would be assisted by the overlapping fields from the neighbouring jets, so that the panel lift would drop not to a quarter, but perhaps only to a half. For this to be possible, however, the shroud itself must be unstalled, and this can be ensured by means of a cold, boundary layer controlling sub-jet which is fed through a manifold supplied by all eight engines."

In the final section of his paper Mr. Davidson discussed future possibilities.

"For long-range operation," he said, "the machine might have an all-up weight of 150,000 lb, a sea-level static thrust of 60,000 lb, and a gross wing area of 2,000 sq ft, with an aspect ratio of 6.0. Then, to yield complete safety with the failure of any one of the six inboard engines, or of both outers, a climb-out speed of about 80 kt would be used. In the event of such a failure the conventional 50ft screen might then be cleared in 500 yards whilst, on all eight engines, the corresponding figure would be just over 350 yd.

"For a landing weight of 110,000 lb, 35 kt has already been suggested as an ideal minimum figure, but this permits of no contingency allowance. With an approach angle of six degrees and an attitude of nine or ten degrees relative to the ground, a speed of some 50 kt would apparently cope with simultaneous baulking and engine failure, while the landing distance from 50ft clearly need not exceed 500 yd.

"Since this sort of thing is immediately possible, what about the future? Again, while any recognizable forecast would be imprudent, certain possible trends can nevertheless be discerned. To take one example, there is the possibility of paring down that margin between 50 and 35 kt, for, at the latter figure, a city-centre airport is conceivable even for the 500 kt transoceanic aircraft. On the engine side this demands a lessened penalty for failure and, since the eight engines each have four separate cylinders, much could be gained by the judicious interlacing of fuel systems.

"Then there is the possibility of using the jet-flap principle on propeller-driven aircraft so as to make full use of the slipstream, and in several respects this type of application seems even more promising than that to the pure jet-driven machine. This is feasible in principle because, under take-off conditions, many turboprop engines yield about twice the power which they do in normal cruising flight. These days most of that extra take-off power goes to the propellers, but it requires no more than a variable-area exhaust slot to extract it instead as additional jet thrust.

"There is still, however, the gust handling problem and this raises a possibly impractical, but nevertheless fascinating, idea. In the bird, control is achieved through a nervous system which determines not only the magnitude of its lift and thrust, but also their spanwise distribution. In a typical jet-flapped aircraft there may be eight propelling engines, each with its own length of shroud which is capable of producing almost any lift-thrust or lift-drag combination independently of the other seven wing panels. No human pilot could ever hope to make use of this facility, nor would the assistance of the thermionic valve be an economic proposition; but, with the coming of the transistor, may not such an aircraft be given ultimately a nervous system of its own?"

In his conclusion, Mr. Davidson said he had limited himself to the work of the original National Gas Turbine Establishment team, the other members of which were Dr. B. S. Stratford and Mr. N. A. Dimmock. Without the former's theory the latter's experiments could not have been designed; and without those there could have been no lecture.

FAIREY'S JET GYRODYNE—PRECURSOR OF THE ROTODYNE

A new aspect of the Fairey Jet Gyrodyne, the first British helicopter to fly with jet rotor-drive. This machine was converted by Fairey, in conjunction with the Helicopter Branch of the Ministry of Supply, from a mechanically powered prototype and is proving a valuable research vehicle for the 44-passenger Rotodyne programme.

Pilot-operated radio telephony

MARCONI SELF-TUNING MULTI-CHANNEL H.F. COMMUNICATION EQUIPMENT. Type AD 307

Illustrated here are
(left)
Drive and Receiver Unit
(centre)
Amplifier Unit
(right)
Modulator Power Unit
Not shown is the automatic Aerial Tuning Unit.

THE TYPE AD 307 equipment is an aircraft transmitter receiver, primarily designed for operation by the pilot. Its features include

- Automatic frequency changing with self-tuning circuits throughout.
- Up to 200 crystal controlled channels
- Valves replaceable by standard American types.
- Remote-control from two alternative positions.
- Self-tuning feature eliminates the need for skilled adjustment.
- 100-120 watts on telephony.
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HATFIELD, HERTS.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Helicopter Rotor Practice

HAVING got so near to the great truth that the articulated rotor (invented by early pioneers because they couldn't make a hingeless blade stay on) has been the greatest single bar to progress in helicopter performance, why does Mr. Payne [whose article appeared in *Flight* of October 14th] stick to his flapping hinge and "restrain it elastically"?

Perhaps I am doing him an injustice and he merely uses the term "stiff hinge" to describe the behaviour of the root of a hingeless blade which is one piece, structurally, with its hub. If this is so, then it is a pleasure to welcome another to the company of those who believe that the hingeless rotor is not only a possibility but is long overdue in practice as a solution to most of the troubles which beset helicopters.

I would like to add one or two points to Mr. Payne's interesting article. He says that a rigid rotor cannot be used above single-seater size but that the stiff hinge can be used on any size. Actually, of course, there is no such thing as a rigid rotor—except in theory. The hingeless rotor, which is nothing more or less than a propeller with a low disc-loading, a low solidity and both cyclic and collective-pitch control, can be built to any size one can envisage. It is interesting to note how reluctant people are at first to use bending as a means of taking load. I can remember when AP.970 said that all aircraft had to be braced biplanes! In those days, no one would have deemed a wing like that of the Princess or the B-52 to be possible—so with hingeless rotor blades.

Mr. Payne dismisses the second-harmonic control (quite rightly in my opinion) but one should not overlook the possibility of interposing a simple, three-dimensional cam into the cyclic-pitch system which distorts the sinusoidal input into the right shape for a range of forward speeds. This is not difficult; I designed a control like this myself a few years ago; and it can have a profound effect upon the life of a hingeless blade.

On the important subject of stability, Mr. Payne expends only one sentence. In my view, this is by far the most significant feature of the hingeless rotor. Not only does it provide a coupling capable of transmitting moments between rotor disc and fuselage but, by offsetting the c.g. forward as well as sideways, one can get rid of the vicious instability with angle of attack which besets all articulated helicopters.

F. H. ROBERTSON.

Holywood, Co. Down.

[Mr. Payne, incidentally, writes to say that he now learns that his article on *The Stiff-hinged Rotor*, quoted in his list of references as appearing in the October issue of *Aircraft Engineering*, is now held over to the November issue of that journal.]

Russian History

THE note by Mr. Austin (Correspondence, October 14th) is welcome. The aeroplane referred to is again the M-9 design of D. P. Grigorovich. Shchetinin were a manufacturing concern in pre-Revolutionary Russia. They were located in Sankt Peterburg, if I remember rightly.

Oxford. DENYS J. VOADEN.

AFTER reading the correspondence in your recent issues on Russian aviation history I must state that Russia holds no place in the development of the aeroplane.

Prior to the issue of the Wright patents in May 1906 no aeroplane had flown with success in Europe, because two fundamental problems remained to be solved. First, no engine sufficiently light enough had been evolved and, second, the control of an aeroplane had not been explored.

It was the Wrights' system of control that made the aeroplane a success.

Southampton. L. HEATHER.

A Pixie Comes to Light

I HAVE acquired a Parnall Pixie Mark III registered G-EBJG. This machine was found in a barn, and if any reader has any parts, drawings, photographs, catalogues or personal experiences with this or any similar aircraft, I would greatly appreciate it if he would contact me. The machine is fitted with a Scott engine, but if I could get a Bristol Cherub, as in the original, I would fit it during restoration.

Caldewgate, Carlisle. D. L. TAYLOR.

[Letters will be forwarded.—Ed.]

High-flying Wildfowl

ON a recent flight I observed four wild ducks (or geese?) flying at a height of 14,000ft.

This is far higher than I ever expected to see birds; perhaps naturalist readers of *Flight* would clarify the situation for me. No doubt there are other pilots who have witnessed similar occurrences.

Biggin Hill, Kent. JASON.

Thrust in Cody's Day

THANK you for your co-operation which has resulted in the revelation by Mr. G. A. Broomfield of the interesting information regarding the methods used by the pioneer aviator Col. S. F. Cody to measure thrust in conjunction with the famous "Cody's Tree" at Farnborough.

I feel sure that there may be other interested observers from the aeronautical sphere who like myself, will be interested to learn of the data obtained from those early experiments.

In the evolution of aeronautics and of the progress and contributions to aeronautical engineering achievement, it is by comparison interesting to note, that whereas Col. Cody estimated his thrust at 350 lb, the modern Heenan and Froude Type F thrust cradle is designed to measure up to 20,000 lb. Such is the march of progress!

L. J. BAYLISS, S/L., Ret.

Longford, Gloucester.

For Posterity . . .

IN connection with your report on the opening of Prestwick's new runway, may I point out, for the sake of the record, that the first official take-off and landing was in fact made by D.H. Rapide G-ALPK piloted by Capt. L. H. Wood, of Air Taxi (Cumberland), Ltd., which had been specially chartered for the purpose by six members of the Prestwick Spotters' Club. The time was shortly after 0800 hr B.S.T., some three hours prior to the take-off and landing mentioned in your report. The event was given some prominence in the Scottish Press. I also hold a letter of confirmation of the fact from the airport commandant.

Prestwick, Ayrshire. DAVID REED, President, Prestwick Spotters' Club.

IN BRIEF

The signature to the letter, last week, from the publicity manager of Auster Aircraft, Ltd., should have read "E. R. Worrall," and not "G. H. Worrall."

FORTHCOMING EVENTS

Oct. 27-28. Aircraft Electrical Society: 12th Annual Display of Aircraft Electrical Equipment, Los Angeles.
Oct. 28. R.Ae.S.: Graduates and Students Section: Dance.
Oct. 28. Aerauto Association (Chelsea College Old Students). Dinner and Dance, Ardington Rooms, London, S.W.4.
Nov. 2. Institute of Welding: Annual Dinner, Park Lane Hotel.
Nov. 2-3. Institute of Welding: Autumn Meeting.
Nov. 3-4. I.A.S. and C.A.I.: Second Annual Joint Meeting, Ottawa.
Nov. 8. R.Ae.S.: Section Lecture: "High Aspect Ratio Wings," by M. Hurel, of Avions-Hurel-Dubois.
Nov. 8. Institute of Metals: "Shape of Grains in Single-phase and Two-phase Alloys," by Prof. C. S. Smith, Sc.D.
Nov. 9. Institute of Transport: Anniversary Luncheon.
Nov. 10. R.Ae.S.: Main Lecture: "Combustion," by Dr. J. S. Clarke, O.B.E., F.R.Ae.S. (At Merthyr Tydfil.)
Nov. 11. Helicopter Association: "Design of Helicopter Operating Sites," by H. T. Hough, M.I.C.E., M.I.Mun.E., M.T.P.I.
Nov. 18. Elstree Flying Club: Informal Reunion of Pre-war Brooklands Flying Club Members.
Dec. 2. Aircraft Golfing Society: Dinner and Dance.
Dec. 16. London Airport Inauguration by H.M. the Queen.

R.Ae.S. Branch Fixtures (to November 24th):—
Oct. 31, *Halton*, "Problems of Space Flight," by F/L. R. W. Durrant. Nov. 1, *Belfast*, "Medical Aspects of High Performance Flight," by W/C. F. Latham; *Boscombe Down*, "Aircraft Engineering and Operations in the Arctic," by Maj. J. H. Webb, U.S.A.F. Nov. 2, *Southampton*, "Flight Refuelling," by P. S. McGregor. Nov. 3, *Isle of Wight*, Annual Dinner. Nov. 7, *Glasgow*, "Earth Satellites," by M. W. Orendon; *Halton*, Films. Nov. 9, *Chester*, "Design Features of the Dart engine," by R. J. Shire. Nov. 10, *Brough*, Second Sir George Cayley Memorial Lecture: "The End of an Epoch in Air Warfare," by Sir John Slessor. Nov. 14, *Bristol*, Junior Members' Papers Competition. Nov. 16, *Manchester*, "Inter-planetary Flight," by E. Burgess. Nov. 24, *Isle of Wight*, "Ejection from High Speed Aircraft," by J. Martin.

THE INDUSTRY

Westland's Year Reviewed

IN his statement to shareholders, issued in advance of the annual general meeting of Westland Aircraft, Ltd., to be held on November 10th, the chairman, Mr. Eric Mensforth, C.B.E., F.R.Ae.S., points out that the company has now been associated with rotary-wing developments for 22 years. He recalls that today the majority of helicopters flying in the United Kingdom and the Commonwealth are Westland-built, and that much pioneering has been done with them. "There come to mind," reports Mr. Mensforth, "such events as the London-Paris record flight, war and rescue operations in the Far East, rescue work following floods, crop dusting, disease control in Central Africa, and experimental scheduled passenger services."

After discussing the progress of the Dragonfly, Widgeon and Whirlwind, the chairman says that his company has recognized that for military transport as well as for civil operations a much larger helicopter is required, a need for which the Westland Westminster—powered by two 3,000 e.h.p. gas turbines and of a gross weight of 33,000 lb—is being developed. "Up to now," says Mr. Mensforth, "this has been a private venture on which considerable expenditure has already been incurred. The company will continue to advance the project with all possible speed and at its own cost, although it can only do this to a point not dangerous to the company's financial stability. Every effort is being made to secure the necessary measure of support in the near future, and before this point is reached, so that work can proceed uninterruptedly and without delay. We have confidence in our ability to make a success of this bold venture, which appears to be received with interest in Government quarters, with whom specific propositions are being discussed." If the work can continue without interruption, says Mr. Mensforth, "there is every hope of service operation by 1960 with, of course, experimental and proving flights earlier."

In his remarks on the company's other activities, the chairman reports that Wyvern production is "now substantially complete," but that much work continues in supporting the aircraft which are now operating in squadron service.

He adds that Normalair, Ltd., the company's principal subsidiary, has once more made a good contribution to the overall profit. The subsidiary has continued to develop and supply air-systems equipment; the Canberra which set up a new height record was Normalair-equipped, as is the English Electric P.1 and all other British high-flying aircraft.

The Westland accounts show a consolidated profit before taxation of £521,888, which compares with £306,069 last year.

Efficient Adhesives

SINCE 1908 the firm of Surridge's Patents, Ltd., of Elmers End, Beckenham, Kent, has specialized in the development and manufacture of "Holdtite" industrial adhesives, and among their more recent introductions is the "Titebond" range, which has found considerable application in the aircraft industry.

Synthetic-rubber-based, the basic grade is "Titebond" No. 22 (to spec. D.T.D. 900/4240), which can be employed for bonding a wide variety of materials, including fabric to wood; fabric to fabric; glass to fabric and porous materials; phenolic sheet to phenolic sheet; and aluminium to aluminium and other non-porous material.

Three methods of application are commonly employed—wet bonding, re-activation of dry coatings, and hot bonding. The third method is employed for obtaining the strongest joint between non-porous surfaces. The parts are first coated and allowed to dry completely. They are then united under moderate mechanical pressure for a period of about three minutes and in a temperature of around 110 deg C (230 deg F). It is stated that when two test-pieces of laminated phenolic sheeting each 1in square are joined by this process the shear strength is in the region of 500 lb. The pieces will show fractures in the material rather than in the joint. "Titebond" joints are resistant to dilute acids and alkalis and to salt solutions, lubricating oils and greases, petroleum spirit and ethylene glycol. The material also has valuable electrical insulation properties.

"Titebond" No. 24 (spec. D.T.D. 900/4/114) is a modification of No. 22, designed to give improved adhesion of rigid surfaces at elevated temperatures.

Other "Holdtite" adhesives used in the aircraft industry include upholstery solutions Nos. 6 and 27; general-purpose cements, Nos. 11 and 11a (rubber to metal, wood, fabric, leather, etc.); and glazing compound No. 12 for windscreens, windows, etc.

Illustrations in the company's catalogue show the interior and exterior of Vickers-Armstrongs' high-altitude test chamber at Weybridge, in which "Holdtite" adhesives were extensively used for the flooring and wall installations.

New Polystyrene Production

FOLLOWING an agreement between the Distillers Company, Ltd., and the Dow Chemical Company of the U.S.A., a new company, Distrene, Ltd., has been formed to manufacture Styron polystyrene in this country. Styron, a Dow product, is a thermoplastic material which has already been used for a wide variety of moulding applications. Manufacture by the Distrene company will take place at Barry, Glamorgan, while sales and technical service will be handled by British Resin Products, Ltd., another member of the Distillers Company group.

Two grades of the material are available; 666, a general-purpose polystyrene, and 475, a toughened version resulting in moulding of high impact strength. Both are primarily processed by injection moulding, but may also be formed by extrusion and compression-moulding techniques. Styron 475 can be extruded into sheet 48in wide, and then shaped by the new vacuum-forming technique. Special extruding equipment for this material is being installed by Ashdowns, Ltd., B.X. Plastics, Ltd., Commercial Plastics, Ltd., and Saro Laminated Wood Products, Ltd., the Distrene company being manufacturers of primary materials only.

Main applications of Styron for aircraft use at present concern battery boxes, battery stoppers, other electrical accessories, food containers, trays and other catering equipment. A good example is a 12-volt aircraft battery developed by Pritchett and Gold, Ltd., of Dagenham, under a Ministry of Supply development contract. It incorporates a six-cell monobloc moulded in Styron 475 by E. K. Cole, Ltd., and is stated to give a weight saving of 14 lb over the conventional former type.

The Distrene plant at Barry, completed last month, has a rated capacity of 6,000-7,000 tons per annum. It adjoins the premises of British Resin Products, manufacturers of synthetic resins and plastics raw materials including Cellobond adhesives and resins, Epok resins and emulsions, Cellomold moulding materials and Rocktite phenolic moulding materials and extrusions. Technical information on the new Styron materials may be obtained from British Resin Products at Devonshire House, Piccadilly, London, W.1, which is also the head office of Distrene, Ltd.

IN BRIEF

Mr. Arthur Hillier, O.B.E., J.P., chairman and managing director of Sperry Gyroscope Co., Ltd., was recently invested with his third foreign decoration: he received from the Italian Ambassador, on behalf of the President of the Italian Republic, the Commendatore of the Order of Merit.

* * *

The Institute of Navigation have appointed Mr. A. M. A. Majendie, M.A., A.F.R.Ae.S., F.I.N., their president for the year 1955-56. Mr. Majendie was flight captain of B.O.A.C.'s Comet fleet until 1954, when he was awarded the gold medal of the Institute for his work in connection with the navigation of jet-transport aircraft. He left the Corporation in that year to join Smiths Aircraft Instruments, Ltd.

* * *

Aerocontacts (Ground Equipment), Ltd., have been appointed sole sales agents outside the United Kingdom for Juniper pressurized fluid-replenishing equipment. The equipment—now being marketed under the company's trade-name "Scoba"—ensures that oils or other fluids, once placed in the replenishing cans, will remain free from risk of contamination. Delivery is made under air pressure provided by a hand pump incorporated in the equipment, thus making it completely self-contained and portable. Juniper cans are in use in some thousands by the R.A.F.

* * *

Claimed to be the first bench-type induction heater available in this country, a compact 3 kW unit is in production by Radio Heaters, Ltd., Eastheath Avenue, Wokingham, Berks. The heater, Radyne C21, is of robust construction, and has an R.F. transformer providing 20 : 1 variable heat-output control.

* * *

The Black and Decker 7in heavy-duty sander has now been replaced by a completely new machine which is claimed to deliver 90 per cent more power and yet is lighter in weight. Known as the 7-inch heavy duty optional-speed sander-grinder, it is available in three models with spindle speeds of 4,200, 5,200 and 6,000 r.p.m., each unit being designed for a specific range of work.

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PROPULSION PROGRESS

Notes on the Past, Present and Future, by a Rolls-Royce Engineer

As part of a symposium held by the University of Delft, Holland, a paper entitled "A General Survey of the History and Development of Aircraft Propulsion" has been prepared by Mr. A. G. Newton, of the Aero Engine Division of Rolls-Royce, Ltd. He read his paper in Delft last Friday, October 21st.

Roughly the first half of Mr. Newton's paper concerned itself with the general requirements of aircraft propulsion, outlining the processes whereby latent heat energy in fuel is converted to propulsive thrust. The lecturer particularly commented upon the far-reaching consequences of the classic paper by Sir B. Melvill Jones in 1927, in which the proposition of the truly streamlined aircraft was first fully discussed. In Fig. 1 a number of aircraft are shown on a graph of brake horse-power required per 1,000 lb weight for given flight speed; and the latest types—such as the Meteor (1942)—lie close to the Jones' ideal curve.

During the first decade of development, aero-engines assumed a great variety of forms, of which all but the air-cooled radial and the air- or liquid-cooled in-line and vee were gradually abandoned. There followed 30 years of refinement, in which such things as supercharging, constant-speed airscrews and anti-detonant fuels brought progressively greater efficiency and higher output. Mr. Newton devoted much of this dissertation to an analysis of the air-cooled engine versus the liquid-cooled, particularly for civil applications.

A special section of the paper recorded the development of the renowned Rolls-Royce Merlin liquid-cooled 12-cyl vee engine. Conceived in 1932, the Merlin passed a 100-hr test at 790 h.p. in 1934, which power was steadily increased to 1,030 h.p. (for a weight of 1,335 lb) by 1939. During World War 2, the Merlin was produced in no less than 52 distinct Marks, to a total of 150,000 engines. By the end of the conflict a full type-test had been passed at a rating of 2,200 h.p. and a specific weight of 0.8 lb/h.p. This was done principally by improving the supercharging to increase the rated altitude, and by developing two-stage supercharging coupled with intermediate charge-cooling; by various mechanical improvements; and by steady improvement in the anti-knock rating and other properties of the fuel.

On 100-octane fuel the maximum boost pressure was 20 lb/sq in, which in the two-stage engine made possible a maximum output of just over 1,800 h.p. The addition of a further 6½ c.c./gal (to a total of 11½ c.c./gal) of tetra-ethyl lead increased the safe boost to 25 lb/sq in, and the power to just over 2,000 b.h.p. This was equivalent to some 30 m.p.h. increase in speed for the Spitfire at sea level. It was finally found that a further considerable increase in knock rating could be achieved by adding 2½ per cent of mono-methyl aniline, resulting in an octane rating of 150. By 1945 this fuel was universally used by the R.A.F. and U.S.A.A.F. on Merlins, and with it a short test was run at 2,400 h.p. Development work was also carried out on turbo-superchargers, with which the maximum Merlin output could have reached 3,000 h.p. This work was terminated by the cessation of hostilities.

Turning to jet propulsion, Mr. Newton observed that the almost complete swing away from the centrifugal compressor in favour of the axial in no way invalidated the correctness of the design-thinking of Sir Frank Whittle. At the time that the early British engines were designed the aim was to get engines running and into the air, and the centrifugal offered far more prospect for the accomplishment of this goal. Nevertheless, even the early turbojet centrifugal was quite a big step forward, in view of the required pressure ratio of 4 : 1 at an efficiency of 75 per cent (existing piston-engine compressors were then working at about 2 : 1, with rather lower efficiency). In spite of the lack of rig-testing facilities, Whittle achieved this target, and also succeeded in driving the compressor with a turbine of higher efficiency than any other known at that time.

In discussing the axial engine versus the centrifugal, Mr. Newton noted that, whereas the thrust per square foot of frontal area had improved from 153 lb/sq ft for the early Welland to 460 lb/sq ft for the Tay, current axial engines were giving better than 1,400 lb/sq ft, albeit at slightly higher flame temperature. Furthermore it was generally accepted that, at higher pressure ratios, the efficiency of the axial was some six to seven per cent better than that of the centrifugal. An exception to the general trend in favour of axials was the case of the small, low-pressure turboprop, in which the diameter of the compressor did not determine the diameter of the engine, and in which the efficiency of the small axial compressor was not high.

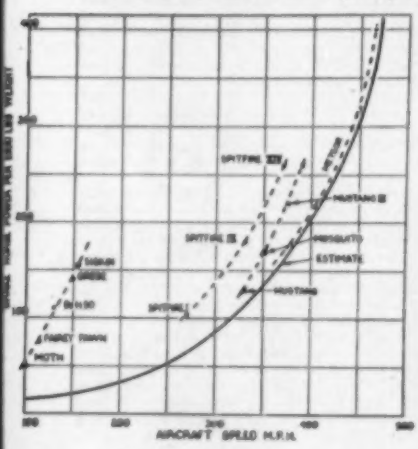


Fig. 1. A plot of power required (per unit weight) for varying forward speeds, by aircraft of differing vintage. Sir B. Melvill Jones' line is the ultimate.

At this point, Mr. Newton produced four curves of general progress in gas turbine development, all plotted with time as the x-axis. The first, of turbojet take-off thrust, continued to increase steeply, and showed no sign of flattening-off. The second, of s.f.c. for a typical flight case for turbojets, was a continuously lowering line, although large reductions in consumption had only followed the introduction of a new engine or component. A similar plot for turboprops highlighted the difference in efficiency between centrifugal and axial engines, due partly to the higher pressure ratio and operating efficiency of the latter, which was in turn partly due to the increase in size of engine. The fourth curve was of specific weight of turbojets at a typical flight condition; it was demonstrated that the rate of progress here was diminishing, partly on account of efforts to improve specific fuel consumption.

The lecturer then briefly outlined the development of his company's Dart turboprop, and of its successor the Tyne (pages 638-9 in our last week's issue), and then went on to comment on the fact that gas-turbine performance—particularly turboprop performance—was limited severely by restriction on maximum flame-temperature.

He went on, "The problem of blade cooling is receiving considerable attention at the moment. The problem is, of course, to obtain adequate cooling with the minimum amount of air and the minimum pressure loss. Obviously the maximum cooling surface area is required for a given cross-sectional area of air flow passages up the blade, and this is best achieved by having a large number of small-diameter holes. This in turn introduces manufacturing problems, but the present indications are that a satisfactory solution is possible. Further progress will necessitate either the injection of water into the cooling air (which is uneconomical for long periods) or the use of sodium in the blade in order to transfer heat to the root where it may be more easily dealt with.

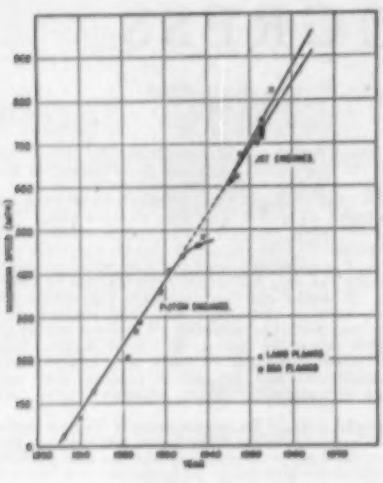
"The other method of raising flame temperature is by improved materials. The advance in turbine-blade materials was relatively rapid during the early days of the turbine engine but it was quite evident, two or three years ago, that the rate of progress in producing better materials was dropping. This is evident if one considers the permissible flame temperature which can be achieved at a particular time with the materials available, assuming a constant stress level. Thus, although there has been a rise of 130 deg C since 1946, 60 per cent of this occurred in the first three years. This effect was not unexpected, and has given impetus to research on blade cooling.

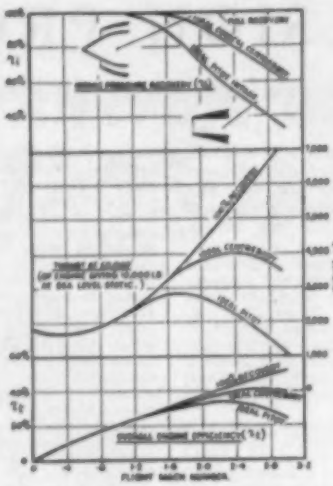
Compressor blading

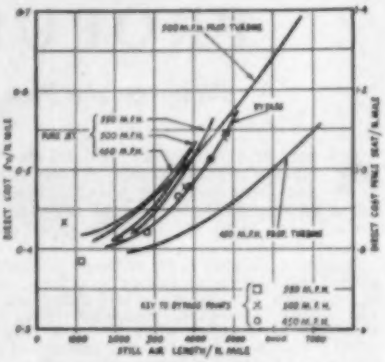
"The mechanical reliability of a compressor rotor blade is dependent to a far less extent than turbine blades on the creep strength of the materials used, or at least this is the case at the moment. The practice has been to use aluminium blades for the early stages of a compressor (say up to 250 deg C under the most adverse flight conditions) the criterion for these blades being fatigue. Initially aluminium bronze was used for the hot end, partly because it had adequate strength and also because it had good forging properties enabling thin trailing edges to be maintained. As techniques improved stainless steels were introduced and, more recently, titanium blades have been incorporated in production engines. With the increase in flight Mach number with the consequent increase in intake temperature, creep strength will eventually supersede fatigue as the deciding factor, and aluminium blades may be completely replaced by titanium, and some of the stainless steels by nickel alloys. It is interesting to note that projected engines may have high-pressure compressor blades working at temperatures higher than some present-day turbine blades.

"From the military point of view, the Air Forces of the world will always be demanding higher speeds and higher altitudes. Although we are led to believe that, once the transonic problems are solved, there is no real bar to very much higher Mach numbers, the effect of increasing Mach number on an aero-engine is still a continuous process and thus one would expect continuous progress. Fig. 2 shows the way in which the World's Air Speed record has increased over the years. It will be seen that the increase in speed is more or less continuous, the effect of the advent of the jet engine being to restore the line of progress when it was beginning to turn over, the average speed increases being about 15 m.p.h. per year, and perhaps a little more in recent years. Admittedly these speeds are attained at sea-level, and the lower temperature at altitude should enable higher speeds to be attained there. The conclusion to be drawn from this curve is that speeds of about $M = 1.2$-1.3 should be attained at sea-level in about 10 years' time, which for the same temperature are equivalent to about $M = 2$ in the stratosphere (this conclusion being, of course, applied to true aircraft, i.e., not guided missiles).

"Probably the main problem of high-speed flight is that of the intake, both from the point of view of efficiency and matching. At high Mach numbers the intake pressure ratio is much higher than that of the engine and thus any inefficiency in the intake will have a correspondingly large effect on the engine performance. Fig. 3 shows this effect for a typical high-supersonic engine and it will be seen that for a Mach number higher than about 1.5, the development of an intake more efficient than the pitot intake is essential. It should be remembered that, at high supersonic speeds, even a low pressure recovery may represent quite a high recovery of energy. For example, at $M = 2.5$, a pressure recovery of 75 per cent is equivalent to an energy recovery







The progress of World Speed Records, Fig. 2 (far left) includes the 822 m.p.h. (F-100C) figure now awaiting ratification. Fig. 3 is a plot of intake efficiencies and Fig. 4 (above) compares transport engine direct operating costs.

PROPULSION PROGRESS . . .

of 93 per cent. The figure also shows that the pure jet, with an efficient intake, can achieve quite a high overall efficiency at high Mach number, e.g., 40 per cent at about M = 2.5. To maintain the overall efficiency at high flight speeds it is essential to operate at high flame temperatures. We have seen that this is dependent on some form of blade cooling, which is made difficult by the high temperature of the cooling air available.

"A further development which should pay handsome dividends at high speeds is the convergent-divergent nozzle. At the moment, most engines operate with a convergent nozzle in which the final jet velocity is sonic and the static pressure at the plane of the nozzle is greater than the ambient atmospheric pressure. At high speeds this discrepancy is intensified and represents a considerable thrust loss over what could be achieved if the gas was expanded supersonically down to atmospheric pressure. For example, at a flight Mach number of 2.0 something like 6 per cent gain in gross thrust is available, and taking account of the (high) intake momentum drag this is equivalent to a gain of about 18 per cent in net thrust and in specific fuel consumption. In practice it may not be possible to achieve the whole of this ideal due to incomplete expansion and irregularities in the nozzle profile but the promised gains are sufficient to warrant further development. A further advantage is that the divergent part has a considerable effect on reducing the base drag or the afterbody drag of the aircraft. On a typical application the net gain in the value of thrust minus drag at M = 2 was estimated to be 32 per cent. As on most attractive features there are associated disadvantages. In this case it is the attendant loss of thrust when the nozzle operates below the design expansion ratio. This can be minimized by varying the nozzle geometry, either mechanically or aerodynamically, but either method will, of course, demand considerable development.

"The indications are that the pure jet engine will still be the powerplant for future high-speed aircraft, certainly up to M = 2.5 and possibly even higher if the developments toward increased flame temperature materialize. With increasing flight speeds the optimum engine pressure ratio will decrease until logically the optimum engine is one in which all of the compression is effected in the intake, i.e., the ramjet. Its inherent lightness together with ease and cheapness of production make the ramjet a very attractive powerplant but unfortunately its characteristics are such that some additional form of thrust boosting is required for take-off and acceleration. This drawback is not so serious in the case of guided weapons, since their requirement of high initial acceleration necessitates some form of thrust boosting in any case.

Transatlantic engines

"One of the 'plums' of the aero-engine business is that of providing engines for the airlines and in particular, in the near future, we shall have the battle for the first non-stop North Atlantic service. The problem of deciding the best type of engine for a duty such as this is very complex. For example, one is apt to regard fuel consumption as of prime importance whereas invariably reduced fuel consumption is only achieved at the expense of increased engine weight. Furthermore, comparisons between different engines are often made by application to the same aircraft, which may be the best configuration for one engine but will certainly not be the best for all engines. For long-range operation, the decision appears to rest between three types of engine—the high-pressure-ratio turbojet, the by-pass engine and the turboprop.

"Basically the gas turbine can be regarded as a means of producing gas at high pressure and temperature. The energy in this gas may then be used in a number of ways:—

(1) By expanding to atmospheric pressure in a nozzle; this is the simple turbojet.

(2) By partially expanding in a turbine driving a fan, and then finally expanding in a nozzle; this is the by-pass engine.

(3) By partially expanding in a turbine driving an airscrew and then finally in a nozzle, giving the turboprop.

"It is obvious that, for a given engine operating cycle, and, therefore, for a given thermal efficiency, the jet efflux of the by-pass engine will be cooler and at a lower pressure than that of the corresponding pure jet. Thus the by-pass engine will give less thrust but will have a better propulsive efficiency and, therefore, a better fuel consumption. A similar improvement in propulsive efficiency of the jet engine can be obtained by operating at a lower flame temperature, but, of course, only at the expense of thermal efficiency. A fairly reliable comparison of a 'cool' pure jet and a by-pass engine has been made and yields the following results. First, if we choose the operating flame temperatures so that each engine is operating near its minimum s.f.c., which is the same in both cases, the installed pure jet will weigh 20 per cent more than the by-pass engine and will give 13 per cent more take-off thrust by overspeeding to the same flame temperature, assuming the same cruise thrust in each case. On this basis the cruising flame temperature of the pure jet would be 120 deg C lower than the by-pass engine.

"Alternatively, taking the same take-off thrust, flame temperature, and pressure ratio in both cases, the installed weights would be the same, but the by-pass engine would have a 4½ per cent advantage in fuel consumption at the same cruise thrust, although its cruise flame temperature would be 45 deg C higher. In either of these cases the by-pass engine would show a range advantage of around 5 per cent. This marginal performance advantage is supported by certain installation advantages due largely to the lower skin temperature of the by-pass engine.

Turboprop limits

"The overall efficiency of the propeller-turbine is largely governed by the efficiency of the propeller, which is dropping rapidly above 450 m.p.h. Fig. 4 shows a comparison between the cool jet, by-pass and propeller-turbine engines on the basis of operating costs. This shows the advantage of the by-pass engine over the pure jet at all stage lengths, and further shows the penalty of operating the propeller-turbine at speeds in excess of 450 m.p.h. When one takes into account the increased weight, the steadily increasing noise level from the propeller at higher flight speeds and the difficulty of designing for safety in the event of failure of any part of the complicated pitch control mechanism, it is felt that one cannot make a case for the propeller turbine above 450 m.p.h. Fig. 4 does, however, emphasize the superiority of the propeller turbine for operation at speeds below 450 m.p.h.

"Although it is always dangerous to generalize, it seems certain that the propeller-turbine will meet the transport requirements up to 450 m.p.h. with the by-pass engine showing a marginal theoretical advantage at higher speeds. As has been stated earlier, this marginal advantage can only be consolidated by having a dependable engine of the correct size available at the right time."

In the next part of his paper, Mr. Newton reviewed the possibilities of "Flying Bedstead" type machines, and discussed the possibilities of scaling engines up and down in size. He finally turned his attention to fuels, and pointed out that gas turbines had not so far required any parallel line of development to the increase in resistance to detonation needed by advanced piston engines.

For hydrocarbons it appeared that no safe fuel was significantly better than any other, on either a weight or volume basis. Boron had about 75 per cent better calorific value than carbon for comparable density, and hydro-borons might be expected to be attractive. At a given air specific impulse, hydro-borons were better on both a volume and a weight basis; the improvement was, however, reduced at high outputs owing to vapourization of the oxide at above 1,800 deg K. The oxide would be liquid at present-day turbine-inlet temperatures, and could therefore deposit or erode. The best application for such fuels might therefore be in afterburners, below 2,000 deg K.

Boron and hydrogen and their compounds were, at stoichiometric conditions, able to give some ten per cent better air specific impulse than kerosine. Values 30 to 35 per cent higher than kerosine were possible—at the cost of very high s.f.c.—by burning magnesium and aluminium (see *Flight* for November 21st, 1952). Work was also going ahead in the investigation of metal, and metal/hydrocarbon, slurries.

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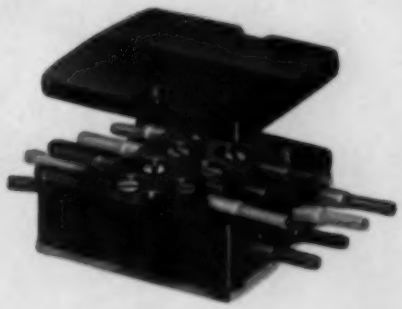

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CIVIL AVIATION

An impression of the Britannia 300 L.R. in the colours of Canadian Pacific Airlines, who last week signed a contract for three of these aircraft with an option for a further five. As recorded on page 668, this is the first dollar order for Bristol's turboprop airliner.

PROGRESS WITH THE COMET 4

WITH design work on the structure of the Comet 4 now virtually complete, de Havilland have reported on the progress made to date. Of particular interest are the precautions taken against fatigue. A fatigue scatter-factor of 6 to 1 has been assumed in the testing of structural specimens, and to date some 3,000 separate tank-tests have been made on Comet 4 fuselage seams, windows, hatches, etc. In addition, full-size wing spars have been subjected to intensive repeated-load tests, as also have wing components on Hatfield's 100-ton fatigue-testing machine. The aim has been to ensure a life of ten years (say 30,000 hours) without cracks (involving tests to 180,000 hours) and a further ten years during which cracks would be small and harmless. A number of components have run to the equivalent of 120 years of "operation" without failure.

Full-scale tests on a modified Transport Command-type Comet 2 are about to begin in a new water tank at Hatfield, together with a major test piece of the Comet 4 (consisting of the centre section and a portion of the fuselage) in confirmation of the individual component tests. Other full-scale Comet 4 components are about to be tested in the existing 30ft tank at Hatfield.

A hint of forthcoming overseas flights by Comets was confirmed recently by de Havillands. It was stated that various flights are under consideration and that arrangements are being made "to cover as many countries and operating conditions as possible." It seems probable that, with the Comet 2 due for its C. of A. by the year's end, the Comet 3 prototype will be the aircraft mainly concerned in such a test programme, which will no doubt provide opportunities for demonstration. The Comet 3 has not yet been abroad.

DECCA APPROVED

IN a statement of United Kingdom policy on short-range navigation aids, the Ministry of Transport and Civil Aviation has expressed the belief that "the maximum flexibility, expedition and safety" of air traffic can be assured only by using the Decca Navigator system. This pronouncement—"following the publication of various reports referring to the TACAN system"—is contained in Civil Aviation Circular No. 110/1955.

In a general introduction, it is stated that the increased volume of air traffic now flying over the U.K. requires more flexible and accurate navigational guidance than that obtainable with M.F. ranges and beacons. The most suitable form of short-range navigational aid for both air navigation and air traffic control, the circular continues, is one providing an accurate, continuous and comprehensive fixing service with a pictorial type of cockpit presentation.

The conclusions of the Ministry's evaluation of the Decca system (reported in *Flight* of May 20th, 1955), it is stated, "have completely supported the United Kingdom's view that, of all existing systems, Decca best meets the A.T.C. requirements for navigation on the U.K. national airways and in control zones."

Concerning other types of radio navigation aids, the circular states:—

"**V.O.R. Beacons.** Since many international civil air transport aircraft are, however, equipped with V.O.R. receivers it has been decided, as an interim measure, to install a limited number of V.O.R. beacons to provide V.H.F. airway track guidance and so fulfil I.C.A.O. obligations.

"**Gee.** This system is accepted where cover is available as adequate for flying United Kingdom airways.

"**M.F. Aids.** With existing Decca coverage and the completion of the V.O.R. installation programme, a number of radio ranges and beacons at present operating in the United Kingdom will be progressively withdrawn . . . There is, however, no likelihood of airborne A.D.F. becoming redundant for many years to come.

"**D.M.E.** The United Kingdom has no plans for the installation of any D.M.E. except a limited number of 200 Mc/s D.M.E. to meet certain B.O.A.C. requirements."

I.A.T.A.'s NEW PRESIDENT

AT the tenth annual general meeting of I.A.T.A., held this year in New York from October 17-21st, Mr. Max Hymans conferred the presidency for 1955-1956 on Mr. Juan Trippe. In his opening address Mr. Hymans said: "We as heads of airlines take an active part in the world towards progress which covers not only the technical field but also—and even more so—the co-operation among the peoples. The task is not always easy and new difficulties arise each year. We have indeed felt them again this year but, far from discouraging us, they make us even more conscious of the necessity of our Association and of its efficiency: the work accomplished so far by I.A.T.A. is probably one of the best examples of the spirit of free discussion and common decision of any enterprises in the field of any organization."

Presenting his annual report to the tenth anniversary general meeting, Sir William P. Hildred asserted that, despite reductions in international airmail payments to airlines, only a few countries have passed on reductions to the public in order to generate a better volume of mail or to make the services more widely available. Sir William urged the 75 member-airlines of I.A.T.A. to resist any attempt to reduce compensation rates further in the 1957 Congress of the Universal Postal Union at Ottawa, which will set foreign air mail rates for the ensuing five years. But he admitted that he is "somewhat pessimistic about the treatment we may expect. There is no appeal from a postal congress. A carrier cannot refuse the instructions of its government and, if forced to do so, we would have to carry the mail for nothing."

ONE HUNDRED HERALDS

AN announcement by Handley Page, Ltd., stated last week that the company is laying down the necessary jigs and tools for the production of 100 Heralds. Orders have been announced for 35 of these four-engined, 36/44-seat transports, with first deliveries beginning in 1957.

Handley Page's faith in the future of the Herald—which was not underwritten by a Government prototype order, and is believed to represent an investment of at least £1m—has already been rewarded by the fact that orders for 29 were received before the prototype first flew in August. Flight trials, which began at Radlett, are now proceeding at Woodley, where the grass surface is more representative of conditions likely to be encountered by Heralds in airline service. An effort may be made in the near future to obtain a limited C. of A., permitting the Herald to go abroad for tropical trials.

The setting-up of a large-scale production line in anticipation of further orders should result in favourable delivery dates—an important step towards securing new customers.

NEW SERVICES APPROVED

THE Minister of Transport and Civil Aviation, after considering the recommendations of the Air Transport Advisory Council, has approved the operation of the following services:—

Air Charter, Ltd.—A vehicle ferry service between Southend and Ostend until June 30th, 1961.

Silver City Airways, Ltd.—A vehicle ferry service between Lydd and Basle (seasonal only, mid-December to end of Easter period each year) until April 30th, 1961.

T.A.A. PROFIT

TRANS-AUSTRALIAN AIRLINES report a profit of £A221,059 for the last financial year, nearly double that of the previous year. The company carried nearly 700,000 paying passengers during 1954-55, a record figure for Australian domestic air transport. Since T.A.A.'s formation in 1946 nearly 4,500,000 paying passengers have been carried on scheduled services without fatality.

The increased wing-span (150ft) of the new Lockheed L.1649 Super Constellation is apparent from this picture of the wind-tunnel model.

CIVIL AVIATION . . .

LOCKHEED AND THE L.1649

FROM Lockheed last week came a progress report and performance details of the L.1649 Super Constellation. Target date for the first flight is October, 1956; a scale metal mock-up of the complete fuselage has been built, and work has started on the machining of the spars of the completely new 150 ft-span wing which will give the new Super Constellation the widest span of any airliner in service. Aspect ratio is 12:1, and wing fuel capacity is increased to 9,600 U.S. gal, 50 per cent more than the standard L.1049's wing. It is reported that the Lockheed engineering department have now issued more than 20,000 of a prospective 30,000 tool orders—evidence of the amount of new design work involved—and that of these 5,000 have been completed in a "crash program" which is stated to be adhering closely to schedule. In the production department 2,300 orders have been completed out of a total of 38,000. Wind-tunnel tests (see photograph) have been completed at speeds up to 570 m.p.h.

The L.1649 fuselage is divided into four separate passenger compartments with seating arrangements varying from 46 (intercontinental "siesta" layout), 58-62 first-class, and 93 tourist. Normal crew for overland operation is five, with provision for up to eleven for over-water flights. The four Wright Turbo-Compound engines deliver 3,400 b.h.p. each for take-off, and cruising power at 22,600ft is 1,810 b.h.p. The choice of Hamilton Standard or Curtiss 16ft 10in, three-blade airscrews is offered. Provision is made for the installation of collision-warning radar, either R.C.A. C-band or Bendix X-band, increasing normal fuselage length by some 2½ft.

Dimensions: Length, 113.58ft; height, 24.75ft; span, 150ft; wing area, 1,850 sq ft.
Weights: Max. gross, 156,000 lb; max. landing, 123,000 lb; max. zero fuel, 116,000 lb; empty, 85,553 lb.
Performance: Take-off to 50ft at 156,000 lb, 6,500ft; landing at 123,000 lb, 3,600ft; max. rate of climb (rated power, 156,000 lb), 1,080 ft/min; stalling speed (max. landing weight and flaps), 101 m.p.h.; max. cruising speed, 350 m.p.h.; max. range (no reserves), 7,000 miles; service ceiling, 25,300ft.

SOUTHEND FACILITIES ENLARGED

AT Southend Airport on October 18th, Mr. John Profumo, M.P., deputizing for the Minister of Transport and Civil Aviation, officially opened the extended terminal building and the new car-handling unit. Describing the increase in flying activity which had made necessary this expansion of facilities, Mr. Profumo pointed out that the number of fare-paying passengers using the airport had increased from less than 9,000 in 1953 to 16,000 in 1954, while the total up to the end of August this year was 29,000. A large number of scheduled international services, operated by the independent companies, were using Southend, and the borough was leading the country in the use of its municipal airport. He congratulated the airport committee in its initiative in encouraging this expansion.

Thanking Mr. Profumo, Councillor Fred H. Woods (chairman of the airport committee) traced the recent development of the airport, and explained that the expansion of facilities for passengers, vehicles and freight had been found necessary sooner than had been expected. However, "We do not want to emulate London Airport," Mr. Woods continued. What was wanted was to maintain the comfortable, friendly atmosphere already associated with Southend Airport, and the new terminal building had been designed to that end.

The airport committee had realized that the provision of hard runways was the next step, for the grass surface had certainly taken a beating this year. As an indication of the council's enthusiasm for such progress, Mr. Woods mentioned that work on the new runways had begun only 48 hr after approval had been received.

Located next to the control tower, the new terminal building is pleasingly simple in design. In the main hall are the counters of the resident operators, agents and the Automobile Association; other facilities include a restaurant, cocktail bar, lounge, and Customs and immigration units. From all public areas of the building there is an excellent view of the aerodrome. The new car-handling unit, adjacent to the terminal, is designed for the Customs clearance of six cars at a time. The runway construction work in progress at present should be completed early next year, and will result in two hard runways (06/24 of 5,270ft and 15/33 of 3,700ft), together with taxi tracks and a marshalling area.

BREVITIES

IN order that the Middle East interests of B.O.A.C. should be grouped in one holding company, Associated British Airlines (Middle East) Ltd., has been formed. The companies concerned are Middle East Airlines, Ltd., Aden Airways, Ltd., Gulf Aviation Co., Ltd., British International Air Lines, Ltd. and Arab Airways (Jerusalem), Ltd.

* * *

On October 17th, the advanced-training division of the Netherlands Government Civil Flying School, together with the school's technical department, moved from Gilze-Rijen to Eelde Airport.

* * *

Lockheed Aircraft Corporation sales during the first nine months of 1955 amounted to nearly £122 million—the largest backlog in the firm's history. During the same period new transports and spares totalling nearly £40 million were delivered. Airlines using Lockheed transports now amount to 31.

* * *

A B.E.A. Viscount *en route* from London to Glasgow on October 19th was inadvertently landed at R.A.F. Abbotsinch instead of at Renfrew. The main runways of the two airfields are in line; cloud base was 900ft and the aircraft was making an I.L.S. approach. The pilot, whose name has not been disclosed, has been reprimanded.

* * *

An independent operator is reported to have placed before the Hull Corporation plans for a trans-Humber helicopter ferry service linking Hull with Grimsby and Scunthorpe. The proposed service would be operated with a nine-seater (presumably a Westland Whirlwind) and it is believed that financial support is being sought from the municipalities concerned.

* * *

Record loads are reported on the Canadian Pacific trans-arctic service between Vancouver and Schiphol. The airline is said to have received 1,000 advanced bookings before the inauguration of the service in July. Since then not one of the DC-6Bs has flown with more than four empty seats. Following the success of the service the Canadian Pacific sales organization has been expanded and new offices have been opened in New York, Los Angeles and Buenos Aires.

This design is now appearing on the nose of B.O.A.C.'s Stratocruisers. It is part of the Corporation's crest, and shows the winged lion in a shield, surmounted by the astral crown.

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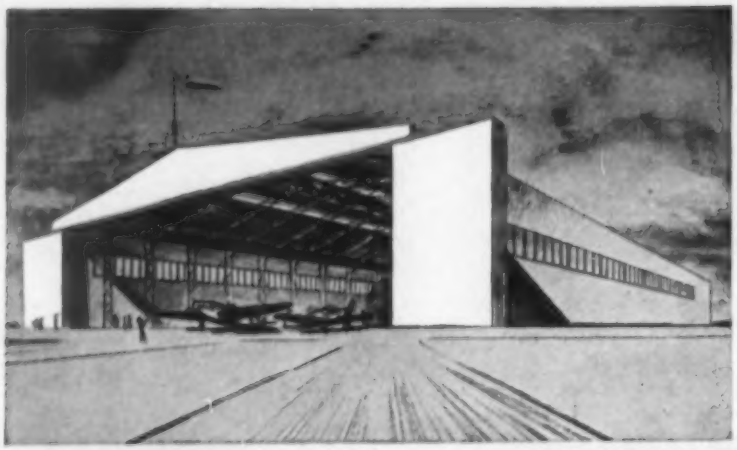

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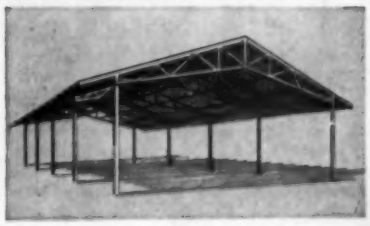

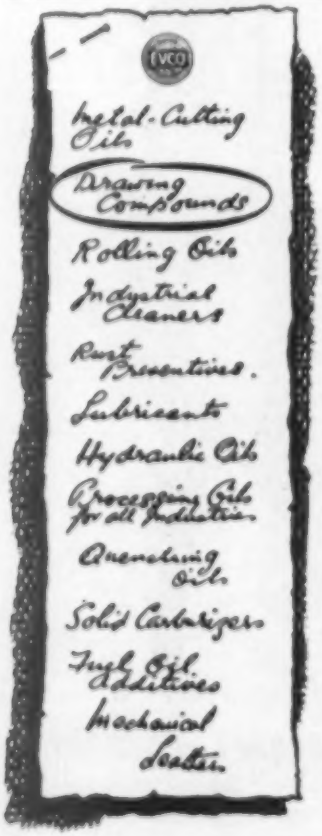

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BLUE RIBAND ROUTE (continued from page 671)

European cities, whereas their European competitors are usually restricted to a single capital at each end of their route. Moreover, the high level of North American salaries provides the U.S. carriers with a relatively and absolutely larger market. Of 203,000 American visitors to Britain last year, 97,000 came by air. Of 52,000 visitors from Canada, with a lower salary *per capita*, only 16,000 came by air.

Such considerations are reflected in the conservative fares philosophy of the smaller European airlines, and in their cautious approach to the mass market.

Nevertheless, two-thirds of the North Atlantic carriers are now committed to re-equipment on a large and expensive scale—as witness the following figures:—

Airline	Aircraft in service	Aircraft on order (and delivery year)
Air France	5 L.1049G	5 L.1049G (1956); 20 L.1649A (1957)
B.O.A.C.	16 Stratocruiser	10 Britannia 300 L.R. (1957); 10 DC-7C (1957)
C.P.A.L.	4 DC-6B	3 Britannia 300 L.R. (1957)
Lufthansa	4 L.1049G	4 L.1049G (1956)
El Al	5 L.049	3 Britannia 300 L.R. (1957)
Iberia	3 L.1049C	
K.L.M.	12 L.1049C; 10 L.749A; 6 DC-6B; 6 DC-6	4 L.1049G (1956); 10 DC-7C (1957)
L.A.I.	3 DC-6; 3 DC-6B	
Loftleidir	DC-4	
P.A.A.	27 Stratocruiser; 45 DC-6B; 7 DC-7B	33 DC-7C (1956-7); 20 Boeing 707 (1959); 25 DC-8 (1960)
Sabena	5 DC-6; 7 DC-6B; 3 DC-6C;	6 DC-7C (1956)
S.A.S.	14 DC-6B; 12 DC-6	14 DC-7C (1957)
Swissair	6 DC-7B	2 DC-7C (1958)
T.C.A.	8 L.1049	
T.W.A.	10 L.1049; 39 L.749; 32 L.049	20 L.1049G (1955-6); 24 L.1649A (1957-8)

It should be noted that the aircraft listed are not all employed on transatlantic routes, and a proportion of those on order may also be assigned to other services. PanAm's Atlantic division, for example, includes ten Boeings, 23 DC-6Bs and seven DC-7Bs, representing about 50 per cent of the company's total fleet of modern long-haulers.

The types now on order, however, were designed primarily to North Atlantic requirements whereas their predecessors could be (and are today) used successfully on stage lengths ranging from 750 to 3,000 miles. The new aircraft are less versatile, and it seems likely that at least 70 per cent of the 180 new machines ordered by the carriers listed above are intended specifically for North Atlantic service. Incidentally, T.C.A. are alone among major carriers in having ordered no new equipment. B.O.A.C., on the other hand, have—theoretically, at least—too many aircraft on order, since their ten DC-7Cs are intended as an "insurance" against delays in the delivery or proving of their ten L.R. Britannias. The idea of a Commonwealth Atlantic partnership, though it has not yet been officially mentioned, appears to have interesting possibilities.

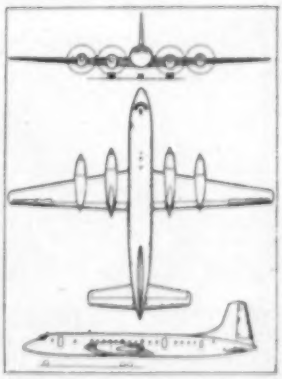
Most of the new transatlantic aircraft on order should be in service by 1958. If provisional estimates of their working capacity prove correct, the outcome of this year's spate of buying will be a sharp upward climb in the capacity-available curve, which has previously shown a fairly steady annual gain of 15-20 per cent. A mixed fleet of say 90 DC-7Cs, L.1649As and Britannia 300 should, by 1958, represent a North Atlantic seat capacity of at least 25 per cent more than the 1955 output. At least half of the aircraft in use today should still be in service in three years' time. These estimates, though conservative, indicate that, if present load factors are to be maintained, North Atlantic traffic must increase by not less than 75 per cent within three years. And if PanAm's 100-seat jet transports, designed to complete the round trip within a day, enter service on schedule, the number of seats to be sold could well increase by a further 75 per cent before 1960.

If capacity is to increase to this extent, lower fares appear to be the only way of attracting sufficient passengers to fill all the extra seats. Much as the public will applaud the ability of the new aircraft to fly between London and New York in nine, or even six, hours instead of 12, there will not necessarily be any drastic increase in the number of people able to afford tickets. It seems, then, that air-sea competition will be intensified within the next few years.

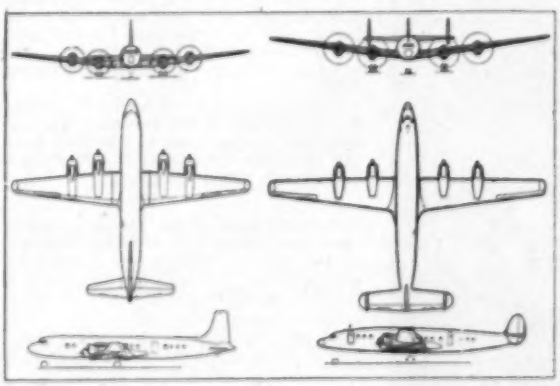
Reducing fares, however, will not be a simple process. The DC-7C and L.1649A are unlikely to show any marked improvement in operating economy over their predecessors. Economies stemming from their ability to cross the Atlantic non-stop in each direction may well be offset by much higher depreciation costs—larger capital investments (exceeding £1m per aircraft) to be spread over a shorter-than-usual period, since the projected transatlantic jets threaten to render them obsolete within three or four years of their introduction to service. The prospect of an hourly depreciation rate approaching £100 is hardly an incentive to the operator to reduce fares. The Britannia, on the other hand, appears a much more attractive proposition, by virtue of its greater revenue-earning capacity; on paper, it is the ideal vehicle for the next stage in the evolution of long-range, low-cost air travel.

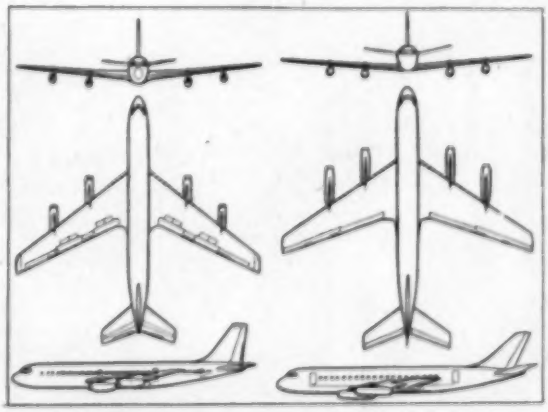
What will be the role of the big jet transports? Douglas credit the DC-8 with 40 per cent lower seat-mile costs than the DC-7C—in which case the jet transport would be better suited than the stretched piston-engined type to the major task of carrying low-fare tourist traffic. Passengers are unlikely to pay higher fares for slower, less comfortable travel; one must therefore conclude that the DC-7C and L.1649A will enjoy a very limited period of first-line service on the North Atlantic route—provided, of course, that the Boeing and Douglas jets are ready on schedule.

Considerations of prestige played an important part in this year's rush to place orders for the DC-7C and L.1649A. Undoubtedly many operators would have preferred to give the Britannia an opportunity of proving itself in service before committing themselves, under pressure of competition, to a further generation of piston-engined airliners. The implications of PanAm's jet order are today receiving very serious consideration in the board-rooms and executive offices of the North Atlantic airlines. Smaller companies must be wishing that re-equipment policies, as well as fares structures, were decided by I.A.T.A. agreement. It will not be surprising if, within the next five years, some of the capacity intended for the North Atlantic is diverted to other less competitive routes.



Drawn here to the same scale are the five types ordered for non-stop service on the North Atlantic route. The wing span and gross weight of each are quoted in brackets (Right) Britannia 300 L.R. (142ft, 170,000 lb); (below, left to right) DC-7C (127ft, 139,000 lb); L.1649A (150ft, 156,000 lb); Stratoliner (131ft, 230,000 lb); DC-8 (135ft, 257,000 lb).





SERVICE AVIATION

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Standard for No. 100 Sqn.

LAST Friday, at Wittering, Air Marshal Sir George Mills, A.O.C.-in-C. Bomber Command, presented a Standard to No. 100 Sqn., which has now been in existence for 38 years. The Squadron has had a distinguished career as a bomber and torpedo bomber unit, and was the first night bomber squadron to join the Independent Air Force in World War I. It served under Viscount Trenchard at that time. Later, while serving in Singapore, it was practically wiped out in an attack on Japanese landing forces and subsequently reformed in Bomber Command. A more detailed history of the unit appears on pp. 673-676 of this issue.

Ely Cathedral Memorial

A STAINED-GLASS memorial window commemorating officers and airmen of Nos. 2, 3, 8 and 100 Groups, Bomber Command, is to be unveiled on Remembrance Sunday, November 6th, by A.V-M. A. McKee, present A.O.C-in-C. Transport Command, who is a New Zealander and spent his whole war-time service in Bomber Command.

Rolls of honour of the four groups will be presented by Air Marshal Sir George Mills, A.O.C-in-C. Bomber Command and the dedication ceremony will be performed by the Lord Bishop of Ely, the Rt. Rev. H. E. Wynn.

Each of the groups will be represented at the ceremony, No. 2 by Air Chief Marshal Sir James Robb, No. 3 by Air Marshal Sir John Baldwin, No. 8 (the pathfinders) by A.V-M. D. C. T. Bennet and No. 100 by A.V-M. E. B. Addison. Overseas commands of the R.A.F. will be represented by Air Chief Marshal Sir Basil Embry.

The stained-glass window, installed in the north side of the nave, has four panels. The left- and right-hand panels show an aircrew and an airman figure over the badges of No. 2 and No. 100 Groups respectively, while the two inner panels contain the badges of the other two groups surmounted by the Archangel Michael (No. 3 Group) and St. George and the dragon (No. 8 Group). The latter panel also incorporates the Lion of St. Mark, the patron saint of the R.N.Z.A.F. The window was designed by Mr. E. Liddall Armitage from preliminary drawings by W/O. P. H. Mason, who was previously with the command and is a student of heraldry.

Relatives and friends who wish to attend the ceremony should apply for tickets to The Precentor, 32 High Street, Ely, Cambs.

No. 194 Sqn. Badge

NOW serving in Malaya with Westland Dragonfly helicopters, No. 194 Sqn. has received approval to adopt a dragonfly for the unit's badge. They will thus follow the example set by many other squadrons in commemorating their aircraft in their badge.

No. 194 was formed in 1942 and is at present commanded by S/L. C. R. Turner. It holds an R.A.F. record in having evacuated over 1,000 casualties. Two of the pilots have each lifted more than a hundred casualties.

The motto is to be *Surrigere Colligere* ("arise and collect") and the badge design will include a Malayan kris.

Chilean Air Force Honour

IT is reported that A.V-M. R. L. R. Atcherley, on a recent tour of South America, was appointed an honorary pilot of the Chilean Air Force. A.V-M. Atcherley is A.O.C-in-C. designate of Flying Training Command.

No. 111 Sqn. History

SINCE all records of No. 111 Sqn. have been lost, and the squadron has recently been reformed at R.A.F. North Weald, Epping, Essex, an appeal has been issued for photographs and information to be sent to the commanding officer by ex-members, so that a new history may be compiled. All material will be treated with care and returned if desired.

Rapid Redeployment

IN the space of four days, earlier this month, two complete infantry battalions were moved from barracks in England to camps on Cyprus by Hastings of Transport Command. The 1st Battalion, Gordon Highlanders, numbering 30 officers and 600 men, was moved in 15 Hastings during one night; and the 1st Battalion, Royal Norfolk Regt., was similarly transported three days later. Carried out at very short notice, the operation has been a fine example of the use—and usefulness—of air transport for strategic purposes.

A similar recent case involved two battalions of infantry and a squadron of the S.A.S. in Malaya. They were flown to Johore state from Kuala Lumpur and immediately deployed in the jungle by Whirlwind helicopters.

During the visit of No. 43 Sqn. ("The Fighting Cocks") to Scandinavia last week their aerobatic team gave a series of first-rate displays. The four members are (standing) F/L. P. Bairsto and Sgt. T. Lampitt and (kneeling) F/O. R. Smith and Sgt. N. Lamb.

Auxiliary Town H.Q.

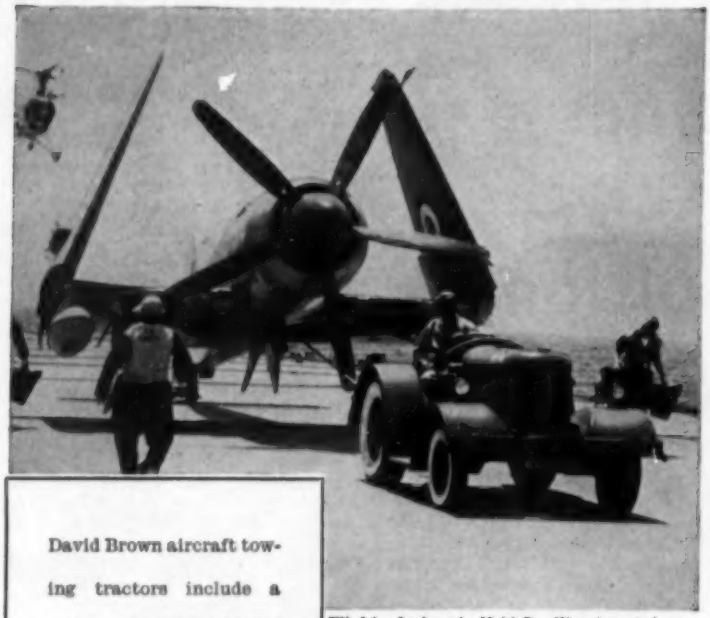
A NEW town headquarters for No. 604 (County of Middlesex) Sqn., R.Aux.A.F., has been opened at 29, Pembridge Gardens, Notting Hill Gate, London. The squadron, commanded by S/L. T. Turnbull, flies its Meteors from North Weald.

Reunions

EX-MEMBERS and friends of 2nd T.A.F. Communications Squadron have met regularly since December 1946 and now meet on the first Friday of each month at The Two Chairmen, Dartmouth Street, London, S.W.1, between 7 and 11 p.m. A special reunion will be held on Saturday, November 12th, at the University of London Air Squadron, 48 Princes Gate, London, S.W.7, at which wives and friends will be welcome. Further particulars from W/C. I. J. Spencer at the foregoing address (telephone Kensington 2433).

No. 56 Squadron will hold a reunion at R.A.F. Waterbeach on Saturday, November 26th. Details can be obtained from the squadron adjutant at R.A.F. Station Waterbeach, Cambridgeshire.

The stained-glass window for Ely cathedral, referred to above. It is here being inspected at the makers' studio by Air Marshal Sir George Mills, A.O.C-in-C. Bomber Command, W/C. D. A. Upton and A.V-M. J. G. Elton.



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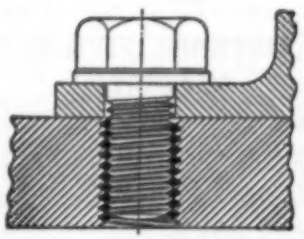

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Please send brief particulars (quoting ref. F/42) to the **Personnel Officer, Saunders-Roe Limited, East Cowes, I.o.W.**

MARSHALL

AIRPORT WORKS CAMBRIDGE

AIRFRAME FITTERS REQUIRED

for long term employment on a variety of multi-jet and turbo-prop aircraft.

Single lodging accommodation available.

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Applications are invited from qualified men for interesting and progressive appointments in the Stress Office of

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The Factory is engaged on a varied and interesting programme of RESEARCH, DESIGN, DEVELOPMENT and PRODUCTION, relating to Aircraft Landing Gear, Propellers, Auxiliary Drive Gearboxes, Air Turbines, Hydraulic and Electro - Hydraulic Devices, Servo Mechanisms and Fuel Flow Proportioners.

These appointments are superannuable.

The Companies' Technical Staff salary range offers attractive starting salaries and good prospects of future advancement. The more senior technical appointments carry monthly staff status with salary scales that extend into the four figure range.

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Applications should be addressed in the first instance to the

Personnel Manager
ROTOL/BRITISH MESSIER LIMITED
CHELTENHAM RD., GLOUCESTER
who will arrange interviews with the Chief Technician.

AIRWORK GENERAL TRADING
COMPANY LIMITED
BLACKBUSHE AIRPORT

have vacancies for the following staff for employment at Blackbushe and London Airport:—

1. Engine Fitters, preference given to applicants with Hercules and Pratt and Whitney experience.
2. Airframe Fitters, preference given to applicants with experience on Hermes, Viking aircraft.
3. Aircraft Electricians.
4. Instrument Mechanics.
5. Radio Mechanics.

Licensed Engineers and Inspectors

1. "A" licensed Engineers with Hermes, Viking, Dakota and DC.4 endorsements.
2. "C" licensed Engineers with Hercules and Pratt and Whitney endorsements.
3. Licensed Electrical Engineers and Inspectors.
4. Licensed Instrument Engineers and Inspectors.
5. Licensed Radio Engineers with "A" endorsements.

Applicants should write giving details of past experience to the Works Manager, **Airwork General Trading Company, Ltd., Blackbushe Airport, Camberley, Surrey.**

CONTACT LENSES

MODERN CONTACT LENSES CENTRE, 7 (D.1), Endsleigh Court, W.C.1. Deferred Terms. Booklet sent. [0342

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INTENSIVE beginners' weekly instructional courses. Conversions on to Olympias for glider pilots in current practice with "B" Certificates. Refunds if bad weather. Write, enclosing s.a.e., Lasham Gliding Centre, Alton, Hants. [4360

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BELLMAN Hangar for sale, 95 ft. by 175 ft. by 19 ft. excellent condition, covered galvanised Easy-fix Steel sheets. Hangar adjustable in size. Much below present day cost. No agents. Write Bellman Hangars, Ltd., Hobart House, London, S.W.1. [4276

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HARRINGAY PHOTO SUPPLIES (FM), 423 Green Lane, N.4. MOU. 2054. [0233

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the under-mentioned applications to operate scheduled air services:—

FROM Derby Aviation, Ltd., of Derby Airport, Burnaston, near Derby.

APPLICATION No. 659. For a Seasonal U.K. Internal Service to be operated with Marathon and Rapide aircraft for the carriage of passengers between Derby, Nottingham (Tollerton), Elstree and Bembridge (Isle of Wight) at a frequency of two to four return flights daily from Derby and Nottingham and two to eight return flights daily from Elstree during the season from April to September inclusive each year for a period of seven years commencing April, 1956.

FOR the following Seasonal Inclusive Tour Services in conjunction with Midland Travel Agents Association for the carriage of passengers for a period of seven years:—

APPLICATION No. 660. For a service to be operated with Dakota and Marathon aircraft between Derby, Nottingham (Tollerton), Birmingham and Bonn/Cologne (Wahn) at a frequency of one return flight weekly, to be operated on Mondays, during the season from April to September inclusive each year, commencing April, 1956.

APPLICATION No. 661. For a service to be operated with Dakota and Marathon aircraft between Derby, Nottingham (Tollerton), Birmingham and Biarritz at a frequency of three to five return flights weekly, to be operated on Fridays, Saturdays and Sundays during the season from April to October inclusive each year, commencing April, 1956.

APPLICATION No. 662. For a service to be operated with Dakota and Marathon aircraft between Derby, Nottingham (Tollerton), Birmingham and Perpignan at a frequency of three to five return flights weekly, to be operated on Fridays, Saturdays and Sundays during the season from April to October inclusive each year, commencing April, 1956.

APPLICATION No. 663. For a service to be operated with Dakota aircraft between Derby, Nottingham (Tollerton), Birmingham and Basle at a frequency of one to two return flights weekly, to be operated on Fridays, during the season from May to September inclusive each year, commencing May, 1956.

(*Continued at top of column* 1, *page* 32)

Applications are invited from experienced Aerodynamicists to fill the following senior positions in the Aerodynamics Office:

(a) **General Aerodynamics**
The positions will involve work on stability and control of current and projected subsonic and supersonic aircraft.

(b) **Internal Aerodynamics**
This work includes all theoretical and design aerodynamics on intakes, ducts, etc.

(c) **Aerophysics**
This work includes basic theoretical and simulator studies on aircraft servo-mechanisms such as autopilots, autostabilisers, etc.

(d) **Project Performance Analysis**
The work covers all aspects of performance estimation on current and future projects and includes the use of digital computational methods.

Applications for the above positions should preferably have an Honours Degree or equivalent in Engineering or Mathematics, and at least two years' experience in the particular field of interest.

Applications, stating age and experience, to:

Chief Designer,
A. V. ROE & CO., LIMITED,
Greengate, Middleton, Manchester.

AERODYNAMICISTS

Applications are invited from qualified men for interesting and progressive appointments in the Stress and Performance Sections of

ROTOL/BRITISH MESSIER LIMITED

The Factory is engaged on a varied and interesting programme of RESEARCH, DESIGN, DEVELOPMENT and PRODUCTION, relating to Aircraft Landing Gear, Propellers, Auxiliary Drive Gearboxes, Air Turbines, Hydraulic and Electro - Hydraulic Devices, Servo-Mechanisms and Fuel Flow Proportioners.

These appointments are superannuable.

The Companies' Technical Staff salary range offers attractive starting salaries and good prospects of future advancement. The more senior technical appointments carry monthly staff status with salary scales that extend into the four figure range.

Applications should be addressed in the first instance to the

Personnel Manager
ROTOL/BRITISH MESSIER LIMITED
CHELTENHAM RD., GLOUCESTER
who will arrange interviews with the Chief Technician.

PUBLIC ANNOUNCEMENTS

(Continued from foot of column 2, page 31)

FROM Hunting-Clan Air Transport, Ltd., of 72, Wigmore Street, London, W.1, for the following Seasonal Inclusive Tour Services to be operated with Viking aircraft in conjunction with Wayfarers Travel Agency, Ltd. for the carriage of passengers for a period of one year, commencing June, 1956:—

APPLICATION No. 664. For a service between London Airport and Milan, for members of the Holiday Fellowship, Ltd. and the Co-operative Holidays Association, at a frequency of one return flight fortnightly to be operated on Sundays during the period 10th June to 2nd September, 1956 inclusive.

APPLICATION No. 665. For a service between London Airport and Perpignan at a frequency of one return flight fortnightly to be operated on Sundays during the period 3rd June to 26th August, 1956 inclusive.

APPLICATION No. 482/1. From Eagle Aviation, Ltd., of 29, Clarges Street, London, W.1, for an amendment to the terms of approval of the Seasonal Inclusive Tour Service which the Company are conditionally approved to operate between London (Blackbushe) and Pisa (San Giusto) at a frequency of two return flights weekly during the period 1st May, 1956 to 31st October, 1956 inclusive, so as to increase their frequency to four return flights weekly.

FROM B.K.S. Air Transport, Ltd., of 1, Marylebone High Street, London, W.1, for the following Seasonal Inclusive Tour Services to be operated with Dakota and Viking aircraft in conjunction with Sky Tourist Services, Ltd. for the carriage of passengers and supplementary freight during the season from April to October inclusive each year for a period of seven years commencing 1st May, 1956:—

APPLICATION No. 666. For a service between Southend and San Sebastian at a frequency of one return flight weekly, to be operated on Fridays or Saturdays.

APPLICATION No. 667. For a service between Southend and Perpignan and/or Barcelona at a frequency of one return flight weekly, to be operated on Mondays.

FROM Fairways (Jersey), Ltd., St. Peters Airport, Jersey, Channel Islands:—

APPLICATION No. 668. For a Seasonal U.K. Internal Service for the carriage of passengers, supplementary freight and mail with Avro XIX and possibly with Dakota or Twin Pioneer aircraft between Jersey and/or Guernsey and Bembridge (Isle of Wight) and/or Portsmouth and/or Luton and/or Cambridge, at an initial frequency of three return flights weekly increasing further in accordance with traffic demand during the season May to September inclusive each year for a period of seven years from 1st May, 1956.

APPLICATION No. 669. For a Seasonal Inclusive Tour Service for the carriage of passengers and supplementary freight with Avro XIX and possibly with Dakota or Twin Pioneer aircraft in conjunction with Jersey and Channel Islands Holiday Tours, Ltd., between Jersey and Guernsey and London (Blackbushe) at a frequency of up to 10 flights daily to be operated on Fridays, Saturdays and Sundays during the season from May to September inclusive each year for a period of seven years from 1st May, 1956.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [4389

PUBLIC APPOINTMENTS

MINISTRY OF SUPPLY requires Engineers (aeronautical, mechanical, electrical) at various experimental establishments chiefly near Farnborough, Hants., Amesbury, Wilts., Aylesbury, Bucks., Bedford and at London headquarters, for research and development work on guided weapons, rockets, gas turbines, armoured fighting vehicles, and aircraft and aircraft equipment including flight test work. Quals. —Higher School Cert. (Science) or equivalent. An H.N.C. or past degree in engineering may be an advantage and some experience in the duties indicated is desirable. Salary according to age, experience, etc., within ranges: Assistant Experimental Officer £320 10s. (age 18) to £700 (London), £306 10s. to £670 (Provinces); Experimental Officer (min. age 26)—£790 to £960 (London), £745 to £920 (Provinces). Women's salary subject to equal pay scheme. Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting C771/5A. [4376

TUITION

ELSTREE FLYING CLUB, Elstree Aerodrome, Herts. The flying school for elementary and advanced training in the south. Instructors' courses, twin-engine conversions, instrument and night flying. M.T.C.A.-approved course for the P.P.L. Catering and bar facilities. Phone: Elstree 3070. [4329

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GLOUCESTER

HAVE VACANCIES ON SUPER-PRIORITY DESIGN AND DEVELOPMENT PROJECTS

FOR

AIRCRAFT DESIGN DRAUGHTSMEN
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Consideration will also be given to Draughtsmen with Mechanical, Structural or Electrical Experience.

Also

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(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

APPLICATIONS STATING AGE, PREVIOUS EXPERIENCE AND EMPLOYERS SHOULD BE ADDRESSED TO THE **CHIEF DESIGNER**

SENIOR TECHNICAL APPOINTMENT

As a result of the continued expansion of the new Design Office, in Central London, the Bristol Aeroplane Company is inviting applications for a Senior Technical Appointment.

The appointment is that of Deputy in charge of a large section responsible for the structural analysis of various aircraft. Experience in this field is essential, combined with some experience of staff supervision at Section Leader level.

A degree in Engineering, Mathematics or Science or an equivalent professional qualification is also necessary.

Applications, outlining details of experience, qualifications and present salary, quoting LDO/JF.9, should be addressed to the **Personnel Manager, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Bristol.**

(I) TECHNICAL INSTRUCTORS
(Airframe and Electrical)

for Aircraft Servicing School; must have had good technical training, sound practical experience in the maintenance of modern aircraft, and be capable of lecturing, drawing instructional diagrams and compiling lecture notes for the use of students.

Applications, quoting date and prefix letter of advertisement, to:

Employment Manager,
VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED
Weybridge Works, Weybridge, Surrey.

Junior Female Mathematicians

Young ladies with G.C.E. advanced level in mathematics required to assist mathematicians in interesting work in Aircraft Design Office. Good commencing salaries according to age and qualifications.

FIVE DAY WEEK

We shall be pleased to discuss this work in a personal interview. Please write in the first instance to:— The Personnel Officer

HAWKER AIRCRAFT LTD.
Canbury Park Road, Kingston-on-Thames, Surrey

SENIOR DESIGNER

A Senior Designer is required to take charge of a section of an important Company, engaged in the design and development of major guided weapon projects, devoted to the mechanical aspects of this subject.

Applicants should possess a university degree or equivalent qualification, and have had considerable experience in the design of aircraft structures. Ability for original thinking is essential.

Applications will be treated in strictest confidence, and you are invited to apply in the first instance to the

Staff Employment Officer, Box No. 6624 c/o Flight.

SENIOR ELECTRONIC AND ELECTRICAL ENGINEERS

Two vacancies exist in an important Company, engaged in the design and development of major guided weapon projects, for Electronic and Electrical Engineers with a degree or equivalent qualifications, and a minimum of seven years experience in either research and development or design.

These are senior posts and carry considerable responsibility. The work covers a wide field in communication systems, electronic instrumentation, and the overall electrical design of guided missiles.

Applications will be treated in strictest confidence, and should be addressed in the first instance to the

Staff Employment Officer, Box No. 6625, c/o Flight.

CHIEF PROJECT DESIGNER

An important Company engaged in the design and development of major guided weapon projects require a Chief Project Designer for work on future designs.

Applicants should have a degree, and preferably have had some post-graduate training. At least seven years' experience is required on either aircraft or guided weapons project design work.

This post is a senior position of considerable responsibility, and carries a high salary. Applications will be treated in strictest confidence, and should be addressed in the first instance to the

Staff Employment Officer, Box No. 6693, c/o "Flight."

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AIR SERVICE TRAINING

the only fully equipped private School of Aviation. Specialist staff, comprehensive equipment and full residential and recreational facilities within the School ensure the soundest training for an Aviation Career.

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courses in primary, intermediate and advanced training for pilots, navigators, radio officers and maintenance engineers.

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THE COLLEGE OF AERONAUTICS

A Course of Lectures on

"AN INTRODUCTION TO ENGINE SYSTEMS"

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THIS course on subsidiary systems is intended primarily for draughtsmen, technicians, and others who wish to obtain an overall knowledge of the subject. LABORATORY and test bed demonstrations will play an important part.

FEES for the course are:

Tuition Fee £10 10 0

Residence Charge (including full board) £7 10 0

FORMS of enrolment can be obtained from The College of Aeronautics, Cranfield, Bletchley, Bucks. [4388

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ALL subjects for professional pilot or navigator licences and ratings embracing Academic, Technical, Simulated and Flying aspects. Full-time personal coaching also short periods. Home-study excellent alternative.

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FLYING BASE: CROYDON AIRPORT. [0277

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Contact the Principal for details of Classroom and Postal Tuition at:

AVIGATION LIMITED

30 Central Chambers, Ealing B'way, London, W.5. Phone: Ealing 8949. [0249

SURREY Flying Club, Croydon Airport, M.C.A. approved for private pilots' licences. Open seven days a week. Croydon 7744. [0293

DERBY AERO CLUB, Burnaston Airport, Derby, the flying school for elementary and advanced training in the Midlands. M.T.C.A.-approved 30-hour course for the P.P.L. Full catering and residential accommodation. Phone: Etwall 323. [4328

FREE: Brochure giving details of courses in all branches aero eng. covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. P26, London, W.4. (Associated with H.M.V.) [0964

SOUTHEND-ON-SEA Municipal Air Centre and Flying School. Comprehensive flying training for all pilots' licences, ratings and endorsements. Special facilities for instruments, night-flying and commercial Pilot licences. No entrance fee or subscriptions. M.T.C.A. approved 30-hour course.

MUNICIPAL Airport, Southend-on-Sea, Essex. Rochford 56204. [0453

A.F.R.Ae.S., A.R.B.Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms; over 95 per cent successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 29 Wright's Lane, London, W.8. [0707

LEARN to fly for £26. Instructors' licences and instrument flying for £3/5/- per hour. Night flying £4/5/- per hour. Residence 5 gns. weekly. Approved M.C.A. private pilot's licence course. Specialized course for junior commercial pilot's licence. Wiltshire School of Flying, Ltd., Thruxton Aerodrome, nr. Andover, Hants. Tel. Weyhill 352. [0253

AERONAUTICAL. Comprehensive full-time technical and practical training for careers in all branches of aviation engineering. Diploma course leads to interesting executive appointments in civil aviation design and development, draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examinations. Write for prospectus to Engineer in Charge, College of Aeronautical Engineering, Chelsea, London, S.W.3. Flaxman 0021. [0019

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

THE ENGLISH ELECTRIC CO., LTD.

Stevenage, Herts.

invite applications for the following positions:

SENIOR METHODS ENGINEERS

APPLICATIONS for these positions are invited from Senior Methods Engineers who are fully experienced in one of the following types of work as applied to prototype or medium quantity production:
(a) Manufacture of Structures (Airframe)
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(c) Manufacture of Electronic Equipment.

THESE senior appointments bear the responsibility for reviewing designs for ease of manufacture, forward planning and investigation of methods of production.

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A NUMBER of vacancies exist in the Production Engineering Department for Planning and Estimating Engineers with experience in light-medium engineering. Applicants should have served a full apprenticeship and should preferably possess H.N.C. or its equivalent.

THESE positions carry attractive salaries with excellent prospects for those showing initiative. A pension scheme is available after a qualifying period, and housing assistance can be given in most cases. Replies should be addressed to Dept. C.P.S., 336/7 Strand, London, W.C.2, quoting Ref. No. 13431. [4357

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FLIGHT DEVELOPMENT ESTABLISHMENT

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AERODYNAMICISTS

VACANCIES exist for Aerodynamicists in Senior and Junior posts both for analysis of future projects and estimations and analysis of results of flight and performance trials now being done. Similar experience desirable, but experience and qualifications relating to aeodynamics on other problems will be considered, if with good basic qualifications. Apply with full particulars to Dept. C.P.S. 336/7 Strand, W.C.2, quoting Ref. No. 13685. [4366

ADMINISTRATIVE POSITION

open to qualified licensed and high experienced engineer used to handling staff and public, with good organising ability and business acumen. Excellent prospects for right man in leading aircraft operating company including air charter, sales, maintenance and flying school. Remuneration will include bonus, paid overseas leave and passages. Apply with full particulars and copies testimonials to Caenpling Bros. & Vanderwal, Ltd., Box 1951, Nairobi, Kenya Colony, B.E.A. [4363

AIR Pilot required by

FALKLAND ISLANDS GOVERNMENT for one tour of 2 years in first instance. Commencing salary according to experience in scale (including expatriation allowance) £900 rising to £960 a year. Free passages for officer and wife and assistance towards children's passages. Furnished quarters available at low rent. Liberal leave on full salary. Candidates must hold a current U.K. C.P.L. and R/T licence and have had 1,600 hours as pilot-in-charge preferably on single-engine aircraft. Seaplane or flying-boat experience an advantage but not essential as conversion to seaplane class can be arranged in Colony if necessary. The officer will be required to fly single-engined seaplanes on internal passenger, freight, mail and ambulance services. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M3B/42889/PE. [4378

CHIEF Flying Instructor, C.F.S., with Commercial licence for flying club. Box 7138. [4374

SAUNDERS-ROE, LTD. have vacancies in the Aerodynamics Department at Osborne, I.W. for JUNIOR technicians.

APPLICATIONS will be welcomed from young men of at least Ordinary National Certificate standard who are keen to be employed on interesting work of an advanced nature in the Wind Tunnel or Flight Test section. Facilities are available in the district for Higher National Certificate courses to be taken.

ASSISTANCE with accommodation is available. Details of age, qualifications, experience, liability for National Service, salary and quoting Ref. F/48, should be addressed to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.W. [4396

H. M. HOBSON LTD.

have vacancies for

TECHNICIANS

interested in the development of several advanced projects dealing with fuel systems for gas turbines, ram-jets and rocket motors.

These posts carry good salaries and offer outstanding prospects of advancement.

5 day week **Restaurant**

Sports and social facilities

Write stating age and full particulars of education and experience to:

H. M. HOBSON LTD.

FORDHOUSES : WOLVERHAMPTON

STAFFS.

MARSHALL

AIRPORT WORKS CAMBRIDGE

have vacancies for

AIRFRAME INSPECTORS
ELECTRICAL INSPECTORS

Modern Houses available for applicants fulfilling specific requirements.

Hostel accommodation for single men.

Long-term employment available on a variety of Multi-Jet and Turbo-Prop, Service and Civilian Aircraft.

Address all applications to
PERSONNEL MANAGER

PLANNING ENGINEERS

Applications invited from men for employment as Planning Engineers. A light engineering background is essential, with preferably a knowledge of Air Ministry modification procedure.

These positions are pensionable, and commencing salaries will be paid according to age and experience.

Applications to:
Personnel Officer,
HAWKER AIRCRAFT LIMITED
Canbury Park Road,
Kingston-on-Thames, Surrey.

HAWKER AIRCRAFT (BLACKPOOL) LTD.

have vacancies for

PROCESS PLANNING ENGINEERS

FOR AIRCRAFT ASSEMBLIES AND DETAIL MANUFACTURE

Applicants must have served full apprenticeship and have wide experience of modern aircraft engineering processes. Good wages for capable men. Pension scheme and welfare facilities.

Apply giving age and full details of experience to:
Personnel Officer, Hawker Aircraft (Blackpool) Ltd.,
South Shore, Blackpool.

SITUATIONS VACANT

AERODYNAMICISTS capable of taking a position of leading responsibility in the high speed section of the Design Department at Osborne are invited to write without delay to the address below.

THE selected applicant will work on a progressive programme of supersonic designs, interesting special projects and associated physics and engineering problems. He will have technical qualifications to Higher Degree standard and adequate applied experience. An attractive salary, good prospects, assistance with housing and participation in assurance and pension schemes are among the advantages which can be offered.

APPLICATIONS (quoting Ref. F/47) should be addressed to Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.W. [4398

FULL-TIME flying instructor wanted. Ex-R.A.F. and private pilot instructors considered.—Lancashire Aero Club, Barton Aerodrome, Eccles, Manchester. [4395

RADIO OFFICERS required for service overseas. 1st class licences. Accommodation and liberal allowances.—Apply Morton Air Services, Croydon 7171. [0014

EXCEPTIONAL opportunity for experienced inspector or licensed engineer for new airframe/engine spares stores. Apply in confidence. Aeroservices, Ltd., Croydon Airport. [4381

TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147

AIRWORK have a vacancy for a Supplies Controller to take charge of provisioning, progress and stores departments at Blackbushe. Only live, energetic persons with considerable previous experience and proved ability in a similar capacity with an airline or aircraft manufacturers should apply. Apply in writing with fullest details of past experience to the Works Manager, Airwork General Trading Co., Ltd., Blackbushe Airport, Camberley, Surrey. [4367

DESIGNERS and Draughtsmen of all grades required for interesting work on gas turbine projects. Salary commensurate with experience and ability. Please write, Ref. D.38, Centrax Power Units Ltd., Victoria Road, Feltham, Middlesex. [4375

DEVELOPMENT engineers and technicians required in research department of a well-known firm of precision engineers, particularly for work in connection with servo systems, small precision motors, and gyroscope instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0146

RATEFIXERS required for aircraft details and assemblies. Applicants must have a good engineering background and be experienced ratefixers. Good salaries and working conditions. Pension scheme.—Apply in confidence to Personnel Officer, Hawker Aircraft (Blackpool), Ltd., South Shore, Blackpool. [4392

A VACANCY exists for a Technical Instructor to lecture on Pilots' Technicals and Flight Engineers' "A" Licences on Hermes, Viking and Dakota aircraft. Apply in writing giving fullest details of previous appointments in similar capacity and past experience to the Works Manager, Airwork General Trading Co., Ltd., Blackbushe Airport, Camberley, Surrey. [4368

ARMSTRONG SIDDELEY MOTORS urgently require experienced checkers and weight estimators in their Aero Engine Drawing Office. Good salaries commensurate with age and experience, also superannuation and insurance scheme.—Applications giving full details to Technical Personnel Manager, Armstrong Siddeley Motors, Coventry, quoting Reference 'CHECK'. [4390

AIRCRAFT instruments manufacturers have a vacancy in their Technical Sales Office for a keen man age 25-30 of good education and preferably with aviation or general engineering background. Interesting work with good commencing salary and excellent prospects. Five-day week. Pension scheme.—Apply Ref. SSE/PLI, S. Smith and Sons (England), Ltd., Cricklewood, N.W.2. [4397

ENGINEER required, 25/30 years of age, for development department of medium sized engineering company situated in Welwyn Garden City, Herts. Applicant would be required to work with existing team in the physical testing laboratory of this company conducting material strength tests and compiling statistics. Applicant must have at least his O.N.C. with a good engineering background. This post offers good prospects with suitable advancement for suitable applicant. Staff pension scheme in existence. Box No. 7190. [4384

SENIOR and Intermediate Draughtsmen required for design and detailing of automobile and aircraft equipment. Above A.E.S.D. rates paid to men with sound mechanical engineering experience. Write Box F915, LPE, 55 St. Martin's Lane, W.C.2. [4383

FLIGHT Engineers required for Viking, York and Viscount aircraft. Minimum qualifications "A" and "C" licences on at least one of the above types. Good pay and conditions. Write Box No. F 918, LPE, 55 St. Martin's Lane, London, W.C.2. [4387

WANTED, DRAUGHTSMEN to design in aluminium for sales development. Must possess Higher National Certificate in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to Northern Aluminium Co., Ltd., Bush House, Aldwych, London, W.C.2. [0348

SENIOR Mechanical Engineer required for rapidly expanding light engineering organisation specialising in fastening devices as used throughout the aircraft and commercial industries. The appointment involves the responsibility and management of a division of the Engineering Department and activities will cover all phases of development, material research, new product design, tool design and production engineering functions. Applicants having experience of such work would be preferred but the following qualifications are essential: good general education, apprenticeship followed by practical work, experience covering wide variety of processes, engineering degree and H.N.C. or equivalent. The post offers an excellent opportunity and scope for advancement to man with flair for development and having organising ability. Age 28-35 years. Staff pension scheme. Factory situated at Welwyn Garden City, Herts. Commencing salary approximately £1,200 per annum. Reply stating full particulars of education and career in chronological order to Box No. 7175. [4377

The following

SENIOR APPOINTMENTS

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